# Factors Affecting Fish Consumption among New Mothers Living in Minnesota, Pennsylvania, and Wisconsin

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## EXECUTIVE SUMMARY

The Great Lakes Consortium for Fish Consumption Advisories is working together to enhance state fish consumption advisory programs by determining how to communicate information to the public more effectively, thereby increasing public knowledge about the risks and benefits of fish consumption and reducing public exposure to toxic substances from consumption of contaminated fish. A primary audience for communication is women of child-bearing age because of both the health benefits and potential health risks to women and their unborn babies. Women can minimize the health risks and maximize the health benefits if they monitor the types and quantities of fish they eat, because contaminants differ according to species and sizes of fish coming from different bodies of water.

To assist the Consortium in their work, Cornell University's Human Dimensions Research Unit conducted a survey of mothers living in three Great Lakes states to better understand factors influencing their fish consumption and suggest ways consortium states could improve their advisory communications to this at-risk group.

The specific objectives of the survey were to:

1. Assess fish consumption behaviors (before, during, and after pregnancy);
2. Identify the most important factors influencing those behaviors;
3. Assess awareness and general knowledge of fish consumption recommendations for women of child-bearing age;
4. Assess use of information sources for fish consumption recommendations; and
5. Assess understanding of terms describing "women of child-bearing age."

### Methods

A sample of 3,000 women who recently gave birth was obtained from the states of Minnesota, Wisconsin, and Pennsylvania (1,000 per state). A mail survey was implemented in April, 2012, with a telephone follow-up survey of 130 non-respondents (55 from MN and 75 from WI) to estimate the degree to which non-respondents differed from respondents. (Pennsylvania would not allow us to contact mothers by telephone, so they were not included in the follow-up survey.)

### Results and Recommendations

Of the 3,000 questionnaires mailed, 100 were undeliverable, and 857 completed questionnaires were returned. The adjusted response rate was 30%. Respondents were more likely to eat at least some fish during pregnancy compared with non-respondents (but there were also a few non-respondents at the other end of the spectrum, eating more fish than respondents). Respondents were more likely than non-respondents to change their fish consumption behavior after they became pregnant by eating less fish than before. They were also more likely to have received information about eating purchased fish for their health and the health of their baby, which might have influenced their change in behavior. No differences were found in awareness of sport-caught fish consumption advice between respondents and non-respondents.

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Our results showed that most women (84%) are consuming at least some fish during pregnancy. The most commonly consumed fish was canned tuna and shellfish. Most women in our study did not identify the taste of fish as being a deterrent to their consumption during pregnancy. The advisory recommendation to eat at least some fish during pregnancy seems to be heeded by most women. However, the amount of fish eaten is well below the levels recommended for almost all of the women. The remainder of this section highlights recommendations for agencies, based on the results from this study.

Increase emphasis on eating at least some low-risk fish during pregnancy. It appears that many women are changing their behavior and consuming less fish in general during pregnancy than before. For example, the percent of women who ate sport-caught fish dropped by half during pregnancy compared to before pregnancy. Our recommendation would be to try to change this behavior by focusing messages on eating healthy fish and describing why it is important to eat healthy fish during pregnancy.

Increase emphasis on eating low-risk fish after pregnancy. After giving birth, women's consumption remained the same or increased a little. Again, communicating with women about the benefits of consuming of less-contaminated fish, even while breastfeeding is important.

High-risk commercial species do not require additional emphasis. Consumption of fish that most organizations recommend against eating seems to be very low (i.e., shark, swordfish, tilefish, or king mackerel). Either through awareness from the advisories or lack of access to these species, it appears that agencies need not be concerned about women of child-bearing age having too much exposure to chemical contaminants from these specific species.

Increase availability of fish consumption information for women prior to pregnancy. Half to two-thirds of women had not received information about fish consumption prior to getting pregnant. If a goal of agencies is to make women aware of recommendations before pregnancy, then communication methods in addition to the OB/GYN offices (a primary source during pregnancy) likely will be needed. Perhaps materials at family practice offices or other means of mass media communication will be needed, particularly for those who may not have regular access to medical care.

Continue targeting information to pregnant women; increase emphasis on eating more less-contaminated fish while pregnant. Women received information primarily during pregnancy about the types of fish and how much fish to eat. The three sources of information used most frequently (health care providers, web sites, and health information brochures) were seen by two-thirds of the mothers as being very useful. Awareness and access to information that women find useful is not a concern to be addressed during pregnancy for most women, but rather we suggest that agencies keep doing what they are doing.

Many women are changing their behavior and consuming less fish during pregnancy than before they were pregnant. The women who had received information during their pregnancy were more likely to have decreased their consumption. Those who had not received information

during pregnancy were more likely to either eat the same amount during pregnancy as before, or not eat fish to begin with. If the decrease was caused by the message, which seems likely, but cannot be proven using our data, then it appears to be the message, rather than the communication method, that needs to change in order to encourage women to eat more of the less-contaminated species.

Targeted communication methods and messages are needed to reach less-educated women. Women with lower education levels ate less fish, were less likely to have received information about fish consumption, were less knowledgeable, and were less likely to try to follow the recommendations. Access to fish was more of a problem for less-educated women than those with a college degree, both when and when not pregnant. Communication with this group should focus on providing information to increase basic knowledge, but also informing/changing beliefs that consumption of less contaminated fish is good for their health and the health of their baby. Women in this group are less likely to seek out information, so methods of communication must focus on putting information where they are likely to see it. Our study findings also indicate that this group is more likely to contain Hispanic women and thus any materials produced for this group might be produced in Spanish as well as English.

Use the terminology of "women who are or could some day become pregnant" instead of "women of child-bearing age." When organizations are giving advice to women of child-bearing age they refer to the group using a variety of terms. Respondents to this study thought the descriptor "women who are or could some day become pregnant" was the best term for describing the group. Simply providing an age range did not appear to describe the group for most respondents.

Explain more clearly advice regarding sport-caught fish; don't assume women know sport-caught fish concepts. Women knew the correct answer to some of the knowledge questions, particularly that children's health can be harmed more than adults, and that chemical contaminants build up over time, but in many cases they indicated they "didn't know." The items that they didn't know about are more often currently associated with advice for sport-caught fish (i.e., older fish, bigger fish, fish that eat other fish have more contaminants), so increasing knowledge for this part of the message, while important for all women, may be especially important for women eating sport-caught fish because many of them didn't know the answers either.

Clarify importance of eating fish before, during, and after pregnancy. A majority of women indicated that they try to follow the recommendations (for types and amounts) in the information that they received, and some of their beliefs support that assertion. For example, three-quarters of women felt that eating fish when they were not pregnant was good for them, but fewer (51%) felt it was good to eat fish for the health of their baby when they were pregnant. Almost 80% of women thought that eating some types of fish when they were pregnant was bad for the baby, but women were less sure of the benefits and risks of fish consumption before pregnancy on the health of their baby. Half thought eating some types of fish was good and one-quarter thought eating some types was bad. About one-third were unsure if eating some types of fish was good or bad. So clarification is needed about which fish are good to eat and why.

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In general, few women (<20%) thought it was very important to eat fish during pregnancy or when not pregnant. About one-third thought it was somewhat important. One-third thought it was not at all important when they were not pregnant; more (38%) thought it was not important during pregnancy. So while they try to follow the recommendations, many didn't think it was very important to eat fish, so more needs to be done to raise the "importance level."

Emphasizing normative beliefs in health advisories is likely unnecessary for most women to stimulate desired fish consumption behaviors. Mothers did not think family and friends held strong views on whether they should eat fish when they were or were not pregnant – one-third were neutral, one-third indicated "don't know." Many mothers' female friends and family members ate fish when they were not pregnant, but fewer consumed fish during pregnancy. Our analysis suggests that these normative beliefs are not that strong of an influence on women's behavior. However, non-white women were more likely than white women to think that their family and friends thought it was important that they ate fish during pregnancy (37% vs. 15%) and when they were not pregnant (44% vs. 31%). This suggests that communication methods that involve social networks might be effective in reaching this group. Also non-white women are less likely to seek out information than white women, so methods of communication should focus on putting information where they are likely to see it.

The most important health advisory messages appear to be that eating fish is good for you and for your baby, that it is important to eat fish, and that it is important to follow health advisory recommendations. In summary, from our examination of factors influencing women to try to follow the recommendations on fish consumption, the strongest connection was from believing that eating fish was good for you and your baby, to thinking it is important to eat fish, to trying to follow the recommendations. What other people think or do is less important, and access is not generally a constraint. Focusing future messages on the most important factors is most likely to change behavior.

Future research could focus on message testing to see what messages would increase women's consumption of less-contaminated fish during pregnancy. Current messages seem related to women decreasing their consumption of all types of fish during pregnancy, even though women say they are trying to follow the recommendations.

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A representative from each state in the Great Lakes Consortium helped formulate the objectives for this study, and reviewed the questionnaire and final report. This group included: Pat McCann (MN), Pam Imm (WI), Tom Barron (PA), Faith Schottenfeld (NY), Michelle Bruneau (MI), Mylynda Shaskus (OH), and Tiffanie Denny (IL). We wish to thank the state agency representatives who assisted us in obtaining the sample of mothers in each state in our study area.

The Survey Research Institute at Cornell University conducted the non-respondent telephone follow-up interviews.

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## INTRODUCTION

Fish consumption has both health benefits and potential health risks, especially for women of child-bearing age. Among the benefits from eating fish are omega-3 fatty acids, which vary according to fish species. Fish are the primary dietary source of omega-3 fatty acids, which are important for development of eyes, brains, and nervous systems (MDH 2012). Potential health risks include exposure to methylmercury, which is most damaging during rapid brain development, particularly for unborn babies (USEPA 1997), and to other chemical contaminants that may occur in fish. Women can minimize the health risks and maximize the health benefits if they monitor the types and quantities of fish they eat, because contaminants differ according to species and sizes of fish coming from different bodies of water.

Fish consumption advisories aim to provide women information about the benefits and risks from fish consumption. Fish consumption advisories have been issued by the federal government, state agencies, tribes, and a variety of non-governmental organizations since the mid-1970s. State agencies have focused primarily on issuing advisories related to the risks of consumption of sport-caught fish in their state. In recent years, attention has also focused on communicating the health benefits related to fish consumption. In some states, fish consumption recommendations have also included commercially-caught fish (i.e., fish purchased in a store or restaurant). Federal and non-governmental organization recommendations have generally focused on commercially-caught fish (hereafter referred to as purchased fish).

Adherence to fish consumption health advisories is voluntary on the part of fish consumers and presumes that they are aware of the recommendations, understand them, and have enough knowledge to make an informed decision about whether to follow them or not (Knuth 1990). However, a variety of studies in different contexts have found that fish consumption advisories are only partially successful in achieving their goals. A number of studies have directly focused on women's fish consumption and awareness of advisory information. We will consider the three most relevant here. The earliest study, conducted in 2003, involved mothers who had recently given birth in Wisconsin. The study found that most women (85%) had consumed fish during the year prior to giving birth, but less than half were familiar with specific fish consumption outreach materials that had been sent to health care professionals (Gliori et al. 2006). Similar fish consumption levels and knowledge levels regarding mercury in fish were found among Minnesota mothers in a study conducted one year after the Wisconsin study (MDH 2012). Both studies reported that more women knew that higher levels of mercury were found in older and carnivorous fish (25-43%) than knew that mercury was found in the meat/flesh and not just in the fat, as is the case with other contaminants such as PCBs (4-10%). A study by Teisl et al. (2011) found that knowledge of the Maine advisory resulted in decreased fish consumption by some women during pregnancy, although some returned to previous levels of consumption after pregnancy. They also found that some women switched their consumption from fish high in mercury to fish lower in mercury. The authors of these studies all suggest improvements are needed to advisory messages to increase knowledge and foster appropriate fish consumption behaviors.

A fourth recent study, by Lauber et al. (2011), conducted focus groups with women of child-bearing age in the Great Lakes basin. The authors found that women recognized that there were

special recommendations for them compared to men, but were uncertain which types of women the recommendations applied to: pregnant women, women who might become pregnant, women under a certain age, or women overall. Similar to the Maine study, Lauber et al. (2011) also found that some women reduced their fish consumption during pregnancy.

While each of these studies has been informative, they have not compared fish consumption behavior or advisory awareness across multiple states, nor looked at factors influencing those behaviors. The study reported here attempts to quantify these findings across representative groups of women from three locations: Minnesota, Pennsylvania, and Wisconsin.

A consortium of the eight Great Lakes states' health, environmental, and natural resource agencies formed in the 1980s to develop shared science-based protocols for fish consumption advice in the Great Lakes (Anderson et al. 1993, McCann et al. 2007). This Consortium has worked together since then, as time and funding have allowed, on various communication tools, data sharing, and additions to the protocols. The Consortium was funded in 2010 by the U.S. Environmental Protection Agency to work together to enhance state fish consumption advisory programs. The general focus of this Consortium project has been on determining how to communicate information to the public more effectively, thereby increasing public knowledge about the risks and benefits of fish consumption and reducing exposure of the public to toxic substances from consumption of contaminated fish.

As part of this work, Cornell University's Human Dimensions Research Unit conducted a survey of mothers living in the Great Lakes states, the subject of this report, in order to better understand factors influencing their fish consumption and suggest ways consortium states could improve their advisory communications to this at-risk group.

The specific objectives of the survey were to:

1. Assess reported fish consumption behaviors (before, during, and after pregnancy);
2. Identify the most important factors perceived to influence those behaviors;
3. Assess awareness and general knowledge of fish consumption recommendations for women of child-bearing age;
4. Assess use of information sources for fish consumption recommendations; and
5. Assess understanding of terms describing "women of child-bearing age."

The Theory of Planned Behavior (Ajzen 1989) was applied to guide identification of factors influencing women's fish consumption and their adherence to the advice they received. The Theory of Planned Behavior postulates that behaviors are influenced by three interrelated factors: (1) attitude toward the behavior (e.g., Does an individual think engaging in the behavior is good or bad?); (2) perceived behavioral control (e.g., How easy or difficult do individuals think the behavior is?); and (3) subjective norms (e.g., What social pressures exist for individuals to engage in the behavior?). These factors are themselves influenced by beliefs about outcomes of performing the behavior (behavioral beliefs), beliefs about the extent to which the behavior is under their control (control beliefs), and beliefs about how specific people or groups feel about performing the behavior (normative beliefs). The Theory was operationalized in the context of adherence to the fish consumption information they received as outlined in Figure 1, with the

general type of questions used shown in each box of the figure and responses generally measured on an agree/disagree scale.

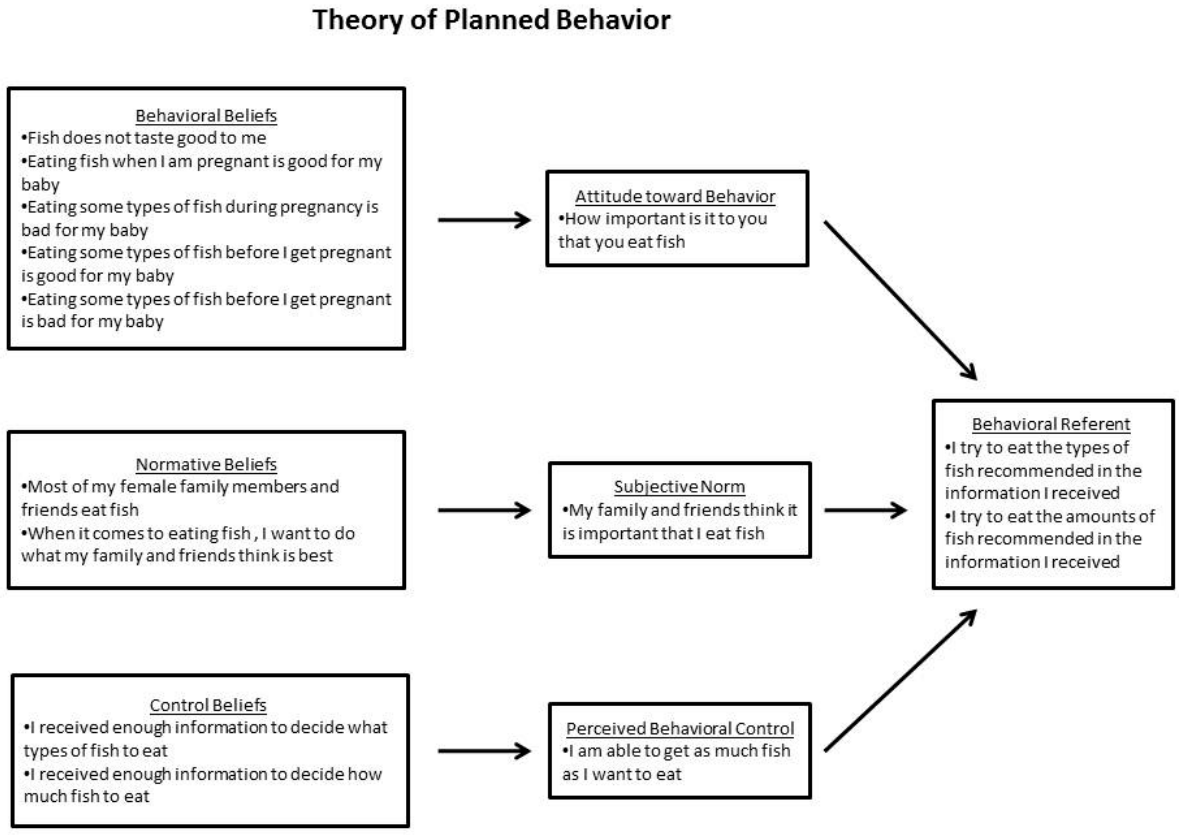



**Figure 1**. Diagram showing the use of the Theory of Planned Behavior as it applies to adherence to the fish consumption information women of child-bearing age received.

## METHODS

### Sample Selection

A sample of 3,000 women who recently gave birth was obtained from the states of Minnesota, Wisconsin, and Pennsylvania (1,000 per state). The sample was drawn from birth records of babies born in the 2 months preceding survey implementation. Mothers of deceased children or whose babies had congenital anomalies were not included in the sample, so as not to give these mothers the impression that their fish consumption might somehow have been related to their babies' condition. Mothers of babies that were adopted or who lived outside the state in which they gave birth were not included.

## Questionnaire Design

The questionnaire was designed in consultation with the members of the Great Lakes Consortium project advisory team, and partially based on previous work so that comparisons with that work would be possible (Connelly et al. 2012, Gliori et al. 2006, MDH 2012, Teisl et al. 2011). Additional questions were added to address the specific project objectives described above, and reviewed by the members of the Great Lakes Consortium project advisory team. The questionnaire (Appendix A) included sections on fish consumption behaviors, advisory awareness and knowledge, sources of information, factors influencing fish consumption behaviors, meaning of terms used in the advisory, and socio-demographic characteristics.

## Mail Survey Implementation and Non-respondent Telephone Follow-up

The mail survey was implemented in April 2012. Up to three follow-up mailings were sent to non-respondents over the course of the next four weeks to encourage their response. As an experiment to further encourage response, a $2 bill was inserted into half of the sample's questionnaires from each state as part of the first mailing. The cover letter indicated the $2 was a small token of our appreciation.

A telephone follow-up survey of 130 non-respondents (55 from MN and 75 from WI) was implemented approximately two months after the first mailing of the questionnaire to estimate the degree to which non-respondents differed from respondents. Pennsylvania would not allow us to contact mothers by telephone, so they were not included in the follow-up survey. Key questions were asked about fish consumption, advisory awareness, and beliefs about the health benefits and risks associated with fish consumption.

## Analysis and Data Weighting

Data from returned questionnaires were entered into a computerized data file and analysis was done using SPSS (IBM SPSS Statistics 20). Chi-square (for comparisons between two nominal/ordinal variables), t-tests and Scheffe's test (for comparisons between two or more categories on a nominal or ordinal independent variable and a continuous dependent variable) were used to test for statistically significant differences between groups of mothers at the $P \leq 0.05$ level. Pearson product-moment correlations were calculated for associations between continuous variables and were reported if they were significantly correlated at $P \leq 0.05$. Path analysis was used to test the strength of the relationships hypothesized in Figure 1. Path analysis involves conducting a series of ordinary least squares regressions on each dependent variable in the diagram (Blalock 1985). The standardized regression coefficients (equivalent in this case to the correlation coefficients) from these models provide a comparable measure of the strength of each hypothesized relationship.

Data reported by state are unweighted and reflect the number of mothers who responded to the survey from that state. However, to make statements about mothers living in the three states combined, or certain target audiences, such as non-white mothers, respondent data were weighted in proportion to the number of births in each state. Consistently collected birth data were available for 2009 from statehealthfacts.org and were used to calculate the weight factors.

Therefore, all overall data reported (across all three states) were weighted in the proportion to the number of births in each state, while state-specific data analyses did not use weights.

## RESULTS

### Mail Survey Response

Of the 3,000 questionnaires mailed, 100 were undeliverable, and 857 completed questionnaires were returned. The adjusted response rate was thus 30% (857 divided by 2,900). Response rates differed by state, with Minnesota being the highest and Pennsylvania the lowest (Table 1). The incentive experiment, where half of the sample was given a $2 bill in the first mailing, resulted in an approximately 10% higher response rate for the sample receiving the incentive compared with the sample not receiving the incentive.

**Table 1. Response rate by state.**

| State | Initial Sample Size | Responses | Response rate adjusted for undeliverables |
|---|---|---|---|
| Minnesota | 1,000 | 313 | 32.6% |
| with $2 incentive | 500 | 187 | 39.2% |
| without $2 incentive | 500 | 126 | 26.1% |
| Pennsylvania | 1,000 | 236 | 24.6% |
| with $2 incentive | 500 | 145 | 30.1% |
| without $2 incentive | 500 | 91 | 19.1% |
| Wisconsin | 1,000 | 308 | 31.3% |
| with $2 incentive | 500 | 177 | 36.1% |
| without $2 incentive | 500 | 131 | 26.7% |
| Overall | 3,000 | 857 | 29.5% |
| with $2 incentive | 1,500 | 509 | 35.1% |
| without $2 incentive | 1,500 | 348 | 24.0% |

### Non-response Bias

Respondents were more likely to eat at least some fish during pregnancy compared with non-respondents (but there were also more non-respondents at the other end of the spectrum, eating more fish than respondents). Respondents were more likely than non-respondents to change their fish consumption behavior after they became pregnant by eating less fish than before. They were also more likely to have received information about eating purchased fish for their health and the health of their baby, which might have influenced their change in behavior.

Non-respondents were more likely to either eat no fish during pregnancy, or eat more than one meal per week compared with respondents, whose consumption was most likely to be intermediary - in the less than one meal per week categories. The majority of non-respondents ate the same amount before and during pregnancy. For non-respondents, receiving information

about eating fish and a change in behavior were not correlated. There were no differences between respondents and non-respondents in the percent who were aware of information about eating sport-caught fish, or the percent who felt they received enough information about the type and amount of fish to eat during pregnancy. Non-respondents were more likely to have fished in the past 12 months than respondents. This difference could explain why non-respondents were as aware of information about eating sport-caught fish as respondents when past research suggests they would be less aware and less active compared to respondents (Connelly et al. 1992, Connelly and Knuth 1993, Connelly et al. 2012). (Statistical comparisons between respondents and non-respondents are detailed in Appendix B.)

**Organization of Results**

All survey results are discussed for the three Great Lakes states together and separately by mother's state of residence. To facilitate communication with women of child-bearing age in the future, there could also be benefits to targeting communication methods or messages to subgroups of women defined by certain socio-demographic characteristics. For this reason, respondents to this survey were grouped by socio-demographic characteristics that defined these audiences, and analysis was done specifically for each sub-group. As results are presented in subsequent sections, statistically significant differences ($p < 0.05$) for these sub-groups are highlighted. If no differences are reported for a particular sub-group when differences for other sub-groups are reported, the reader may assume there were no significant differences for that sub-group. The concluding sections of the report discuss recommendations for communication strategies informed by these socio-demographic differences.

**Respondent Characteristics**

Respondents ranged in age from 18 to 45, with a mean age of 30 (Table 2). There was no difference in mean age between the states.

The majority of respondents had received at least a college degree (Table 2). It is likely that our respondents are more educated than the population from which they were drawn, based on comparisons with the US Census. However, an exact comparison is not possible because our sample includes only women within a limited age group who recently gave birth, and the Census reports data for all state residents. There was some difference in education level between the states, with Pennsylvania respondents averaging fewer years of formal education than Minnesota and Wisconsin women. Based on responses to this variable, we created three education-level sub-groups for analysis – those with a high school diploma or less, those with some college, and those with a college or graduate degree.

As expected, education was highly correlated with income (0.66), so we decided not to create sub-groups by income category. A comparable number of respondents identified within each of the five income categories (Table 2). Average household income was slightly higher in Minnesota compared to Wisconsin. Pennsylvania households were more likely to be at either end of the income spectrum than Minnesota or Wisconsin households.

Most respondents self-identified as White and not of Hispanic origin, with no differences by state (Table 2). Our sample seems to have fewer Black or African American women than US Census data might suggest. Women of Hispanic origin were three times more likely than non-Hispanic women to have only a high school degree or less. Thus, when considering differences by education level later in this report, readers should keep in mind the higher proportion of potentially Spanish-speaking members of the less-educated group. We will also revisit the implications of this association in the recommendations section. White respondents (including a few of Hispanic origin) were compared with all other non-White respondents grouped together, as no other racial group comprised a high-enough proportion of the sample to be examined as a distinct sub-group with sufficient statistical precision. The relationship between education and Hispanic origin was not seen between White and non-White respondents.

**Table 2.** Characteristics of responding mothers and their households.

| Respondent Characteristics | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Age (mean)** | 29.6 | 29.8 | 29.5 | 29.5 |
| | | Percent | | |
| **Education*** | | | | |
| Less than high school | 4.3 | 1.9 | 5.6 | 3.9 |
| High school diploma/G.E.D. | 11.5 | 5.2 | 13.7 | 13.1 |
| Some college or technical school | 16.8 | 17.1 | 16.7 | 16.7 |
| Associate's degree | 13.5 | 16.8 | 14.2 | 8.8 |
| College undergraduate degree (e.g., B.A., B.S.) | 31.1 | 39.3 | 25.8 | 34.0 |
| Graduate or professional degree (e.g., M.S., Ph.D., M.D., J.D.) | 22.8 | 19.7 | 24.0 | 23.5 |
| *College degree or higher from Census data of state residents*** | | *31.8* | *26.7* | *26.0* |
| **Hispanic, Latino, or Spanish Origin** | | | | |
| No | 92.0 | 94.1 | 90.1 | 93.8 |
| Yes | 8.0 | 5.9 | 9.9 | 6.2 |
| *Census data of state residents*** | | *4.9* | *6.1* | *5.9* |
| **Race***** | | | | |
| White | 88.4 | 89.6 | 86.3 | 91.5 |
| Black or African American | 4.0 | 2.9 | 5.2 | 2.6 |
| *Black or African American from Census data of state residents*** | | *5.4* | *11.1* | *6.5* |
| Asian or Pacific Islander | 5.4 | 6.1 | 5.6 | 4.2 |
| Native American Indian | 2.2 | 1.9 | 3.0 | 1.0 |
| Other | 3.3 | 2.3 | 4.3 | 2.3 |
| **Most recent pregnancy the first** | | | | |
| No | 58.7 | 61.3 | 55.7 | 62.2 |
| Yes | 41.3 | 38.7 | 44.3 | 37.8 |
| **Breastfeed after most recent pregnancy*** | | | | |
| No | 16.4 | 9.4 | 22.6 | 10.7 |
| Yes | 83.6 | 90.6 | 77.4 | 89.3 |
| *Ever breastfed from CDC**** | | *82.5* | *63.4* | *73.7* |
| **Fished in past 12 months*** | | | | |
| No | 84.0 | 74.9 | 91.8 | 76.8 |
| Yes | 16.0 | 25.1 | 8.2 | 23.2 |

Continued on next page

**Table 2** Continued

| Household Characteristics | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Other household members have fished in past 12 months*** | | | | |
| No | 62.2 | 54.3 | 69.1 | 55.9 |
| Yes | 37.8 | 45.7 | 30.9 | 44.1 |
| | | | | |
| **Income*** | | | | |
| < $25,000 | 19.1 | 13.4 | 23.7 | 15.2 |
| $25,000 to $49,999 | 17.4 | 19.1 | 15.4 | 19.9 |
| $50,000 to 74,999 | 21.7 | 20.7 | 19.7 | 26.5 |
| $75,000 to $99,999 | 16.8 | 17.4 | 14.5 | 21.2 |
| $100,000 or more | 25.0 | 29.4 | 26.7 | 17.2 |

* Statically significant difference between states at $P \leq 0.05$ using chi-square test.

**Source: http://quickfacts.census.gov/qfd/index.html

*** Percentages add to more than 100% because more than one race can be checked.

****Source: http://www.cdc.gov/breastfeeding/pdf/2011breastfeedingreportcard.pdf

For the majority of women, their most recent childbirth was not their first pregnancy (Table 2). Almost all women in Minnesota and Wisconsin, and three-quarters in Pennsylvania, breastfed after their most recent pregnancy. This is important to know because chemical contaminants can be transferred to the baby through breast milk. A slightly higher percentage of women in our sample appeared to have breastfed compared with data from the CDC, suggesting our respondents may be more health-conscience or health-aware than the population of women who recently gave birth in each state.

Women in Minnesota and Wisconsin, as well as members of their households, were more likely to have gone fishing in the past 12 months than women or their household members in Pennsylvania (Table 2). The overall percent fishing is higher than the national average (14% [USFWS 2012]), so respondents to this survey may be more likely to know about the sport-caught fish advisories than the general population.

**Fish Consumption Before, During, and After Pregnancy**

Many women reported changing their fish consumption during pregnancy compared to before they became pregnant (Table 3). In general, they reported eating less (a little less or a lot less) fish during pregnancy than before becoming pregnant. After pregnancy, most continued to eat the same amount of fish as they had eaten during pregnancy, or a little bit more (Table 4). There were no differences between the three states.

During pregnancy, 16% of respondents reported eating no fish at all (Table 5). Current federal guidelines suggest that women of child-bearing age "Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury" (http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/FoodbornePathogensContaminants/Methylmercury/ucm115662.htm). Most ate less than the two meals per week recommended by

the government. There were no differences in these measures of reported fish consumption between the three states.

**Table 3.** Changes in amount of fish meals consumed during pregnancy compared to before pregnancy (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| Did not eat fish or shellfish before or during pregnancy | 12.9 | 13.2 | 13.4 | 11.3 |
| Ate a lot more during pregnancy compared to before | 1.4 | 1.4 | 1.3 | 1.8 |
| Ate a little more | 5.5 | 5.8 | 4.9 | 6.4 |
| Ate the same amount | 29.4 | 29.1 | 27.2 | 34.4 |
| Ate a little less | 25.3 | 24.0 | 27.8 | 21.3 |
| Ate a lot less | 19.2 | 17.3 | 20.5 | 18.4 |
| Stopped eating | 6.3 | 9.2 | 4.9 | 6.4 |

**Table 4.** Changes in amount of fish meals consumed after the baby was born compared to during pregnancy (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| Did not eat fish or shellfish during or after pregnancy | 13.4 | 14.3 | 13.4 | 12.7 |
| Ate a lot more after pregnancy compared to during | 5.2 | 3.4 | 6.7 | 3.9 |
| Ate a little more | 24.3 | 21.8 | 25.9 | 22.9 |
| Ate the same amount | 43.9 | 43.8 | 42.5 | 47.1 |
| Ate a little less | 7.6 | 8.2 | 7.1 | 8.1 |
| Ate a lot less | 3.1 | 4.1 | 3.1 | 2.1 |
| Stopped eating | 2.5 | 4.4 | 1.3 | 3.2 |

**Table 5.** Sport-caught and purchased fish consumption of new mothers during pregnancy (percent), overall and by state of residence.

| Fish consumption during pregnancy | Overall | MN | PA | WI |
|---|---|---|---|---|
| None | 16.0 | 17.0 | 15.2 | 16.6 |
| Less than 1 meal a month | 21.6 | 26.6 | 19.5 | 21.2 |
| 1 to 3 meals a month | 43.0 | 43.2 | 43.8 | 41.4 |
| At least 1 meal per week | 15.4 | 9.6 | 17.7 | 16.2 |
| At least 2 meals per week | 3.2 | 2.6 | 3.0 | 4.3 |
| 3 or more meals per week | 0.5 | 1.0 | 0.4 | 0.0 |
| Don't know | 0.3 | 0.0 | 0.4 | 0.3 |

Shellfish and canned "light" tuna were the most likely fish to be consumed by women before, during, and after pregnancy (Table 6). However, many different species of purchased fish were consumed. Among women who ate purchased fish before pregnancy, two-thirds ate fish from 3 or more categories in Table 6. There were some important differences by state, so we replicated Table 6 separately for each state (Tables 7-9). In general, women living in Pennsylvania were more likely to eat shellfish, canned "white" tuna, or the category including tuna, halibut, orange roughy and Chilean sea bass than women living in Minnesota or Wisconsin. The percent of women eating salmon or canned "light" tuna did not differ by state.

Very few women ate shark, swordfish, tilefish, or king mackerel before becoming pregnant (Table 6). These are species that many organizations recommend women of child-bearing age do not consume at all. Almost no women ate these fish during or after pregnancy.

The percentage of women who ate sport-caught fish dropped by half during pregnancy compared to before pregnancy and did not rebound after pregnancy (Table 6). (Note: the period after pregnancy for these women [February-April] was not a time when many sport-caught fish are caught.) This was the case in each state, but the percentage who consumed sport-caught fish started out much lower in Pennsylvania compared to the other two states (Tables 7-9).

Women with higher levels of formal education were more likely to eat fish before, during, and after pregnancy than less-educated women (Appendix Tables C-1 through C-3). They were more likely to consume shellfish, purchased salmon, and the category including tuna, halibut, orange roughy, and Chilean seabass, than less-educated women. This trend may be closely related to income (education and income are highly correlated) because these species tend to be more expensive. Women with higher-levels of formal education were also more likely to consume the "do not eat" species of shark, swordfish, tilefish, and king mackerel, also perhaps as a result of access to these typically more expensive fish.

Although more-educated women were more likely to indicate that they ate fish during pregnancy (Appendix Table C-4), they were also more likely to say that they decreased the amount consumed during pregnancy compared to before they were pregnant (Appendix Table C-5). After pregnancy, these women were also more likely to say they increased their consumption compared to when they were pregnant (Appendix Table C-6).

Women with at least some college education were more likely to eat sport-caught fish before, during, and after pregnancy than those with a high school education or less (Appendix Tables C-1 through C-3). Similarly white women were more likely than non-white women to eat sport-caught fish before (27% vs. 17%), during (12% vs. 4%), and after (12% vs. 3%) pregnancy. There were no other racial differences found that were similar to the education/income differences reported above.

**Table 6.** Types of fish eaten by new mothers in study area states before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 11.3 | 14.3 | 13.7 |
| Sport-caught fish | 25.3 | 10.7 | 10.9 |
| Shellfish | 69.2 | 59.8 | 54.5 |
| Canned “light” tuna | 54.4 | 40.8 | 39.2 |
| Caned “white” tuna (albacore) | 39.0 | 25.4 | 26.1 |
| Salmon | 46.9 | 36.5 | 33.2 |
| Tuna, halibut, orange roughy or Chilean seabass | 24.9 | 9.3 | 13.8 |
| Shark, swordfish, tilefish or king mackerel | 8.3 | 0.7 | 2.1 |
| Other purchased fish | 51.8 | 44.2 | 41.1 |

**Table 7.** Types of fish eaten by Minnesota new mothers before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 12.1 | 14.4 | 16.6 |
| Sport-caught fish | 37.4 | 19.2 | 17.6 |
| Shellfish | 67.1 | 55.6 | 44.4 |
| Canned “light” tuna | 54.0 | 41.5 | 34.5 |
| Caned “white” tuna (albacore) | 34.2 | 20.4 | 19.8 |
| Salmon | 47.0 | 39.3 | 30.7 |
| Tuna, halibut, orange roughy or Chilean seabass | 24.3 | 6.7 | 8.3 |
| Shark, swordfish, tilefish or king mackerel | 7.3 | 1.0 | 1.3 |
| Other purchased fish | 48.2 | 41.2 | 31.3 |

**Table 8.** Types of fish eaten by Wisconsin new mothers before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 11.0 | 13.0 | 12.7 |
| Sport-caught fish | 33.1 | 19.8 | 18.2 |
| Shellfish | 63.6 | 51.9 | 48.4 |
| Canned “light” tuna | 57.8 | 42.2 | 41.6 |
| Caned “white” tuna (albacore) | 30.8 | 19.8 | 20.5 |
| Salmon | 45.8 | 30.5 | 28.2 |
| Tuna, halibut, orange roughy or Chilean seabass | 21.1 | 6.5 | 9.4 |
| Shark, swordfish, tilefish or king mackerel | 5.2 | 0.3 | 1.0 |
| Other purchased fish | 54.9 | 50.0 | 42.9 |

**Table 9.** Types of fish eaten by Pennsylvania new mothers before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 11.0 | 14.8 | 12.7 |
| Sport-caught fish | 15.7 | 2.1 | 4.2 |
| Shellfish | 72.9 | 65.7 | 62.3 |
| Canned “light” tuna | 53.0 | 39.8 | 40.3 |
| Caned “white” tuna (albacore) | 45.3 | 30.5 | 31.8 |
| Salmon | 47.5 | 38.1 | 36.9 |
| Tuna, halibut, orange roughy or Chilean seabass | 27.1 | 11.9 | 18.6 |
| Shark, swordfish, tilefish or king mackerel | 10.2 | 0.8 | 3.0 |
| Other purchased fish | 52.1 | 42.8 | 44.9 |

**Awareness and Understanding of Fish Consumption Advisories**

Women reported receiving information about the types of fish and how much fish to eat more so during pregnancy than before becoming pregnant or after giving birth (Table 10). Some received this information before pregnancy, but few indicated getting information after pregnancy. More women reported receiving information about purchased fish than sport-caught fish. Three-quarters of all women reported receiving information about purchased fish at some point. Two-thirds (66%) of women who fished or had a household member that fished in the past 12 months had received information about sport-caught fish at some point. Women living in Minnesota were more likely to have received information about sport-caught fish, especially during

pregnancy, than women living in Pennsylvania or Wisconsin. This was also true for purchased fish, but the differences between the states were less-pronounced.

Most women who had a college degree indicated that they had received information about sport-caught (68%) or purchased fish (87%) compared to only about half of the women who had a high school degree or less (Table 11). The difference based on education was most striking during pregnancy, when 73% of women with a college degree received information about consumption of purchased fish compared to 46% of those with a high school degree or less. There were differences in the percentage who received information between white and non-white women before pregnancy (29% vs. 11% received sport-caught information, 39% vs. 25% received purchased fish information), but these differences disappeared over time as 62% of white women and 57% of non-white women had received sport-caught fish information at some point and 78% of white women and 72% of non-white women received purchased fish information at some point.

Most women who consumed fish during pregnancy had received information about the types and amounts of fish to eat during or prior to becoming pregnant (Table 12). This was true for both sport-caught and purchased fish consumption. Women eating fish prior to becoming pregnant were not as likely to have received information. Many women who ate shark, swordfish, tilefish, or king mackerel (fish not recommended for women of childbearing age) prior to becoming pregnant indicated they had received information about purchased fish (52% in MN, 36% in PA, 60% in WI). The few who consumed these fish during or after pregnancy almost always indicated they had received information. Almost all of the women who consumed fish after giving birth and who were breastfeeding their baby had received information at some point (Table 12).

Women who had received information during pregnancy, either about sport-caught or purchased fish, were more likely to indicate that they ate less fish during pregnancy than before becoming pregnant (Table 13). Women who did not receive information during pregnancy were more likely to either eat the same amount during pregnancy as before, or not eat fish to begin with. The differences in Table 13 are significant, but we cannot say that receiving information caused women to eat less fish, just that there is a relationship.

**Table 10.** Received information about sport-caught or purchased fish consumption before, during, after pregnancy, or at some point (percent checking*), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| Sport-caught fish information | | | | |
| Before I got pregnant** | 26.6 | 37.1 | 18.5 | 33.1 |
| During pregnancy** | 44.6 | 61.9 | 34.7 | 48.0 |
| After giving birth | 7.2 | 9.3 | 6.8 | 6.0 |
| At some point** | 61.2 | 79.4 | 50.9 | 64.8 |
| Purchased fish information | | | | |
| Before I got pregnant** | 37.3 | 45.7 | 32.0 | 40.2 |
| During pregnancy** | 65.5 | 75.3 | 62.6 | 61.6 |
| After giving birth** | 10.6 | 13.4 | 10.8 | 7.1 |
| At some point** | 77.2 | 88.0 | 73.4 | 74.4 |

* Percentages do not add to 100% because women could receive information during multiple time periods.

**Statically significant difference between states at $P \leq 0.05$ using chi-square test.

**Table 11.** Received information about sport-caught or purchased fish consumption during pregnancy or at some point (percent checking*), by education level.

| | HS diploma or less | Some college | College or graduate degree |
|---|---|---|---|
| **Received information during pregnancy on** | | | |
| Sport-caught fish** | 30.6 | 43.3 | 49.5 |
| Purchased fish** | 46.3 | 61.6 | 73.3 |
| **Received information at some point on** | | | |
| Sport-caught fish** | 45.5 | 57.6 | 67.9 |
| Purchased fish** | 54.5 | 72.2 | 86.8 |

* Percentages do not add to 100% because women could receive information during multiple time periods.

**Statically significant difference between groups at $P \leq 0.05$ using chi-square test.

**Table 12.** For those consuming the fish type during the period, percent who have gotten information about that fishing type prior to or during that period, by state of residence.

| | MN | PA | WI |
|---|---|---|---|
| Consuming: | % receiving relevant information | | |
| **Sport-caught fish** | | | |
| Before pregnancy | 45.5 | 35.1 | 40.7 |
| During pregnancy | 89.7 | - - | 82.4 |
| After giving birth and breastfeeding | 97.8 | - - | 89.5 |
| **Purchased fish** | | | |
| Before pregnancy* | 48.0 | 35.0 | 43.5 |
| During pregnancy* | 92.2 | 78.5 | 79.2 |
| After giving birth and breastfeeding* | 92.2 | 82.6 | 80.6 |

- - sample size < 30

*Statically significant difference between states at $P \leq 0.05$ using chi-square test.

**Table 13.** Relationship between receiving information about eating fish during pregnancy and changes in the amount of fish meals consumed during pregnancy compared to before pregnancy.

| | During pregnancy | | | |
|---|---|---|---|---|
| | Received sport-caught fish information* | | Received purchased fish information* | |
| Change in amount of fish meals consumed during pregnancy compared to before | No | Yes | No | Yes |
| | **Percent** | | | |
| Did not eat fish or shellfish before or during pregnancy | 16.4 | 7.0 | 25.3 | 5.4 |
| Ate a lot more during pregnancy compared to before | 2.3 | 0.6 | 1.8 | 1.3 |
| Ate a little more | 5.5 | 5.6 | 3.7 | 6.5 |
| Ate the same amount | 30.6 | 28.4 | 31.8 | 28.5 |
| Ate a little less | 22.6 | 28.7 | 16.5 | 30.0 |
| Ate a lot less | 15.3 | 24.4 | 13.2 | 22.7 |
| Stopped eating | 7.3 | 5.3 | 7.7 | 5.6 |

* Statistically significant difference between groups at $P \leq 0.05$ using chi-square test.

Respondent's advisory knowledge was tested with eight statements (four generally true, two generally false, one false but asked of only MN respondents, and one asking for respondent's self-assessment of knowledge). At least one-third of the respondents agreed with each true statement (up to two-thirds for two of the statements), but one-quarter or less disagreed with the false statements (Table 14 and more detailed data in Appendix Table C-7). In almost all cases, and especially for the false statements, the majority of respondents indicated that they didn't know the correct answer. Respondents were more likely to select "don't know" than to choose an incorrect answer. There were no significant differences in answers to the knowledge questions between mothers living in different states.

**Table 14.** Knowledge of advisory information (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Children's health can be harmed more than adult's health by chemical contaminants in fish** *(generally true)* | | | | |
| Strongly agree or agree | 59.5 | 58.4 | 61.2 | 57.0 |
| Neutral | 7.1 | 7.1 | 7.0 | 7.2 |
| Strongly disagree or disagree | 2.2 | 4.5 | 0.9 | 2.6 |
| Don't know | 31.2 | 30.0 | 30.9 | 33.2 |
| **Some chemical contaminants from eating fish build up in my body over time** *(generally true)* | | | | |
| Strongly agree or agree | 57.9 | 59.5 | 56.9 | 58.5 |
| Neutral | 10.9 | 13.2 | 10.1 | 10.1 |
| Strongly disagree or disagree | 5.5 | 4.8 | 5.7 | 5.6 |
| Don't know | 25.7 | 22.5 | 27.3 | 25.8 |
| **Older fish generally have more chemical contaminants in them than younger fish** *(generally true)* | | | | |
| Strongly agree or agree | 43.2 | 50.2 | 38.7 | 45.1 |
| Neutral | 10.2 | 12.3 | 9.1 | 10.1 |
| Strongly disagree or disagree | 5.1 | 4.9 | 5.7 | 4.2 |
| Don't know | 41.5 | 32.6 | 46.5 | 40.6 |
| **Fish that eat other fish tend to have more chemical contaminants than fish that eat other things** *(generally true)* | | | | |
| Strongly agree or agree | 31.8 | 36.1 | 29.6 | 32.3 |
| Neutral | 10.8 | 10.7 | 10.4 | 11.8 |
| Strongly disagree or disagree | 5.1 | 4.8 | 4.3 | 6.9 |
| Don't know | 52.3 | 48.4 | 55.7 | 49.0 |
| **I know which fish eat other fish and which fish eat other things** | | | | |
| Strongly agree or agree | 14.9 | 15.8 | 13.5 | 17.0 |
| Neutral | 12.1 | 13.5 | 12.2 | 10.5 |
| Strongly disagree or disagree | 24.4 | 25.4 | 23.1 | 26.3 |
| Don't know | 48.6 | 45.3 | 51.2 | 46.2 |
| **Fish from lakes outside the metro area are safer to eat than fish from lakes inside the metro area** *(generally false)* | | | | |
| Strongly agree or agree | -- | 19.0 | -- | -- |
| Neutral | -- | 14.2 | -- | -- |
| Strongly disagree or disagree | -- | 17.4 | -- | -- |
| Don't know | -- | 49.4 | -- | -- |

Continued on next page

**Table 14** Continued

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Smaller fish generally have more chemical contaminants in them than larger fish** *(generally false)* | | | | |
| Strongly agree or agree | 3.1 | 4.5 | 2.6 | 3.0 |
| Neutral | 10.6 | 10.6 | 10.0 | 11.8 |
| Strongly disagree or disagree | 25.6 | 32.3 | 23.0 | 24.0 |
| Don't know | 60.7 | 52.6 | 64.4 | 61.2 |
| **Most of the mercury is found in the fat of fish** *(generally false)* | | | | |
| Strongly agree or agree | 20.2 | 21.6 | 19.2 | 20.7 |
| Neutral | 11.7 | 11.6 | 10.5 | 14.1 |
| Strongly disagree or disagree | 4.1 | 4.2 | 3.9 | 4.6 |
| Don't know | 64.1 | 62.6 | 66.4 | 60.6 |

– Question asked only of Minnesota mothers.

A knowledge score was created using the six true/false items asked of all respondents, and reflects the number of correct responses ranging from 0 to 6 (Table 15). (Those who didn't know or were incorrect received a zero for that item.) The knowledge questions were not designed to comprehensively measure knowledge but to reflect the types of messages states hoped were reaching fish consumers. For this audience, only one-quarter of respondents answered 4 or more items correctly. The mean was 2.2 items answered correctly. There were no differences in average knowledge between the states. However as might be expected, women who had received information about sport-caught fish had a higher average score than women who had not received information (2.4 vs. 1.9). Similarly, women who had received information about purchased fish had a higher average score than women who had not received information (2.4 vs. 1.6).

Two items that might be viewed as testing general knowledge about chemical contaminants in fish - children's health can be harmed more than adult's health by chemical contaminants in fish, and some chemical contaminants from eating fish build up in my body over time – were answered correctly by over half of the respondents; one-third or fewer did not know, with only 5% or fewer answering incorrectly (Table 14). The other five items testing knowledge (e.g., older fish, larger fish, fish that eat other fish have more chemical contaminants) are discussed more frequently in the context of sport-caught fish consumption, and thus it is not surprising that this audience of mothers were more likely to say they didn't know than give a correct answer. When we look more specifically at mothers who ate sport-caught fish, the proportion indicating "don't know" decreases and the proportion answering correctly increases for some of the items – older fish, larger fish have more contaminants, but not for others (Appendix Table C-8), indicating knowledge is still low among this more select audience. Half of the Minnesota mothers indicated they did not know if fish from lakes outside the metro area are safer to eat than fish inside the metro area; few (17%) answered correctly by disagreeing with the statement. Fewer than 5% of respondents knew that most mercury is not found in the fat of the fish; almost two-thirds did not know.

In the case of the knowledge question concerning the level of contaminants in fish which eat other fish versus fish which eat other things, most women indicated they do not know which fish eat other fish (Table 14). Only 15% of mothers said they knew which fish eat other fish, so it would be difficult for them to follow the advice of eating fish that do not eat other fish.

**Table 15**. Knowledge score, overall and by state of residence.

| Knowledge Score | Percent |
|---|---|
| 0 items correct | 19.7 |
| 1 item correct | 19.7 |
| 2 items correct | 17.4 |
| 3 items correct | 18.9 |
| 4 items correct | 12.3 |
| 5 items correct | 11.4 |
| 6 items correct | 0.6 |
| | Mean |
| **Overall** | 2.2 |
| State of Residence | |
| Minnesota | 2.4 |
| Pennsylvania | 2.1 |
| Wisconsin | 2.2 |

Education level was strongly related to knowledge of advisory information. Women with a college degree were two to three times more likely to answer the knowledge questions correctly than women with a high school degree or less (Table 16). Women with less education were much more likely to say they don't know. The one exception was for the generally false item "most of the mercury is found in the fat of fish" where those with a college degree were more likely than those with less education to incorrectly agree with this statement. Still the majority of respondents indicated they "don't know" when it comes to this statement.

**Table 16.** Knowledge of advisory information (percent), by education level.

| Knowledge of advisory information | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **Children's health can be harmed more than adult's health by chemical contaminants in fish** *(generally true)* | | | | |
| Education* | | | | |
| HS diploma or less | 35.7 | 15.5 | 3.1 | 45.7 |
| Some college | 59.7 | 6.7 | 2.0 | 31.6 |
| College or graduate degree | 66.6 | 4.9 | 2.0 | 26.5 |

Continued on next page

**Table 16** Continued

| Knowledge of advisory information | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **Some chemical contaminants from eating fish build up in my body over time** *(generally true)* | | | | |
| Education* | | | | |
| HS diploma or less | 23.2 | 14.4 | 8.0 | 54.4 |
| Some college | 54.4 | 16.9 | 5.9 | 22.8 |
| College or graduate degree | 69.5 | 6.4 | 4.4 | 19.7 |
| **Older fish generally have more chemical contaminants in them than younger fish** *(generally true)* | | | | |
| Education* | | | | |
| HS diploma or less | 31.5 | 13.1 | 7.7 | 47.7 |
| Some college | 35.0 | 14.2 | 4.7 | 46.1 |
| College or graduate degree | 50.5 | 7.0 | 4.6 | 37.9 |
| **Fish that eat other fish tend to have more chemical contaminants than fish that eat other things** *(generally true)* | | | | |
| Education* | | | | |
| HS diploma or less | 17.7 | 16.9 | 3.8 | 61.6 |
| Some college | 21.7 | 12.6 | 5.5 | 60.2 |
| College or graduate degree | 41.2 | 8.2 | 5.5 | 45.1 |
| **I know which fish eat other fish and which fish eat other things** | | | | |
| Education* | | | | |
| HS diploma or less | 9.3 | 17.1 | 11.6 | 62.0 |
| Some college | 9.9 | 12.7 | 17.9 | 59.5 |
| College or graduate degree | 18.9 | 9.9 | 32.2 | 39.0 |
| **Smaller fish generally have more chemical contaminants in them than larger fish** *(generally false)* | | | | |
| Education* | | | | |
| HS diploma or less | 4.7 | 14.8 | 13.3 | 67.2 |
| Some college | 3.5 | 11.8 | 16.1 | 68.6 |
| College or graduate degree | 2.4 | 8.8 | 34.0 | 54.8 |
| **Most of the mercury is found in the fat of the fish** *(generally false)* | | | | |
| Education* | | | | |
| HS diploma or less | 14.1 | 20.3 | 2.3 | 63.3 |
| Some college | 15.1 | 12.3 | 4.8 | 67.8 |
| College or graduate degree | 24.7 | 8.8 | 4.2 | 62.3 |

* Statistically significant difference between groups at $P \leq 0.05$ using chi-square test.

**Sources of Information and Their Perceived Usefulness**

Over half of the mothers reported three sources that provided them with information about eating fish for their health or the health of their baby – health care providers (78%), web sites (60%), and health information brochures (52%; Table 17). Friends or family provided information to about one-third of the mothers. All other sources listed were used by less than 10% of respondents. Other sources written in by respondents were primarily baby or pregnancy books. Web sites and health care providers were more likely to be sources of information for more-educated women and white women than less educated and non-white women (not reported in tables; web sites – 68% with college degree, 38% with HS or less, 61% white, 46% non-white; health care providers – 81% with college degree, 68% HS or less, 80% white, 58% non-white). Minnesota mothers were much more likely than Wisconsin or Pennsylvania mothers to get information from their health care providers or from health information brochures. Pennsylvania mothers, and to a slightly lesser extent Wisconsin mothers, were more likely to access web sites for information than mothers in Minnesota.

Minnesota mothers were more likely to report having someone give them information about eating fish, presumably health care providers, than women in the other two states (Table 18). There were no differences by state in the proportion of women who sought out information about eating fish (41%) or those who just happened to come across information (22%). White women and those with a college degree were two to three times as likely to look or ask for information about eating fish than non-white or less educated women (44% white vs. 22% non-white; 51% with college degree vs. 31% with some college vs.18% with HS or less).

**Table 17**. Sources used for information about eating fish for your health or your baby's health (percent checking*), overall and by state of residence.

| Sources of information | Overall | MN | PA | WI |
|---|---|---|---|---|
| My health care providers** | 77.8 | 83.0 | 76.9 | 73.9 |
| Web sites** | 60.0 | 51.7 | 65.1 | 59.1 |
| Health information brochures** | 51.6 | 65.5 | 45.6 | 47.8 |
| Friends or family | 30.5 | 25.3 | 31.4 | 34.8 |
| Newspaper articles | 9.6 | 7.9 | 10.6 | 9.6 |
| iPhone/Smartphone apps | 9.4 | 7.6 | 10.7 | 9.1 |
| TV or radio reports | 7.8 | 7.9 | 8.3 | 6.5 |
| Fishing regulations guide | 6.9 | 9.8 | 5.3 | 6.5 |
| Wallet-sized cards | 4.0 | 3.0 | 5.3 | 2.6 |
| Other information sources | 9.7 | 6.1 | 11.2 | 10.9 |

*Percentages add to more than 100% because more than one source could be checked.

**Statically significant difference between states at $P \leq 0.05$ using chi-square test.

**Table 18**. Ways women got fish consumption information (percent checking*), overall and by state of residence.

| Ways women got information | Overall | MN | PA | WI |
|---|---|---|---|---|
| I looked or asked for information about eating fish | 41.4 | 36.9 | 42.4 | 44.8 |
| Someone gave me information** | 70.6 | 80.4 | 67.6 | 65.6 |
| I just happened to come across information | 22.0 | 16.5 | 22.4 | 27.6 |

*Percentages add to more than 100% because more than one way could be used.

**Statically significant difference between states at $P \leq 0.05$ using chi-square test.

The three sources of information used most frequently (health care providers, web sites, and health information brochures) were seen by two-thirds of the mothers as being very useful (Table 19). Friends and family, the next most frequently used source, were seen as somewhat useful by approximately half of the mothers. Other sources used less frequently but seen as very useful by half or more of the mothers that used them included iPhone/Smartphone apps, wallet-sized cards, and the fishing regulations guide. There were no differences between mothers in different states in terms of the usefulness of sources. (Some sources did not have sufficient use for state-by-state analysis of their usefulness.)

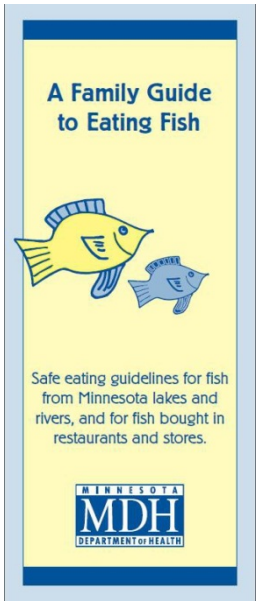
Minnesota and Wisconsin produce brochures shown in Figure 2 that advise women of child-bearing age on the types and amounts of fish they should be consuming. Pennsylvania does not produce such a brochure but provides advice for women in their fishing regulations guide. We asked respondents if they recalled seeing these specific brochures and in the case of Minnesota and Wisconsin mothers if they could recall where they saw the brochure. Almost two-thirds of Minnesota mothers recalled the brochure, with most seeing it in the obstetric or OB/GYN doctor's clinic (Table 20). An earlier study in Minnesota (2004) found that 37% of new mothers had seen a very similar brochure, with most recalling having seen it in the OB/GYN doctor's clinic (MDH 2012). Few Wisconsin mothers recalled seeing their brochure, but among those that did, they were most likely to recall seeing it in the obstetric or OB/GYN doctor's clinic or a WIC clinic. An earlier study in Wisconsin (2003) also found that few women (13%) recalled seeing a similar brochure, with the most common place for women to have seen outreach materials, including the brochure, being the OB/GYN doctor's clinic (Gliori et al. 2006). Very few Pennsylvania mothers (8%) had ever read the section of the Pennsylvania fishing summary that lists fish consumption advice by waterway; 3% were unsure and the remainder (89%) indicated they had not read it.

**Table 19.** Usefulness of sources among mothers using them for providing information about eating fish for their health or their baby's health (percent), overall and by state of residence.

| Sources of information | Overall | MN | PA | WI |
|---|---|---|---|---|
| **My health care providers** | | | | |
| Not at all useful | 2.5 | 2.7 | 2.3 | 2.9 |
| Somewhat useful | 31.7 | 30.5 | 34.6 | 27.4 |
| Very useful | 65.8 | 66.8 | 63.1 | 69.7 |
| **Web sites** | | | | |
| Not at all useful | 1.2 | 2.1 | 0.0 | 2.8 |
| Somewhat useful | 33.8 | 40.4 | 31.3 | 33.1 |
| Very useful | 65.0 | 57.5 | 68.7 | 64.1 |
| **Health information brochures** | | | | |
| Not at all useful | 1.5 | 3.4 | 0.0 | 1.7 |
| Somewhat useful | 33.4 | 35.2 | 31.0 | 35.4 |
| Very useful | 65.1 | 61.4 | 69.0 | 62.9 |
| **Friends or family** | | | | |
| Not at all useful | 8.7 | 11.1 | 7.3 | 9.1 |
| Somewhat useful | 55.0 | 57.0 | 56.3 | 50.6 |
| Very useful | 36.3 | 31.9 | 36.4 | 40.3 |
| **Newspaper articles** | | | | |
| Not at all useful | 20.7 | -- | -- | -- |
| Somewhat useful | 47.0 | -- | -- | -- |
| Very useful | 32.3 | -- | -- | -- |
| **iPhone/Smartphone apps** | | | | |
| Not at all useful | 16.1 | -- | -- | -- |
| Somewhat useful | 25.9 | -- | -- | -- |
| Very useful | 58.0 | -- | -- | -- |
| **TV or radio reports** | | | | |
| Not at all useful | 14.1 | -- | -- | -- |
| Somewhat useful | 56.7 | -- | -- | -- |
| Very useful | 29.2 | -- | -- | -- |
| **Fishing regulations guide** | | | | |
| Not at all useful | 25.1 | -- | -- | -- |
| Somewhat useful | 26.9 | -- | -- | -- |
| Very useful | 48.0 | -- | -- | -- |
| **Wallet-sized cards** | | | | |
| Not at all useful | 39.9 | -- | -- | -- |
| Somewhat useful | 11.0 | -- | -- | -- |
| Very useful | 49.1 | -- | -- | -- |
| **Other information sources** | | | | |
| Not at all useful | 10.3 | -- | -- | -- |
| Somewhat useful | 24.7 | -- | -- | -- |
| Very useful | 65.0 | -- | -- | -- |

--Sample size <30

Minnesota




Wisconsin


Pennsylvania


**Figure 2**. Fish advisory materials by state.

**Table 20.** Exposure to the brochure produced by the state for women of child-bearing age, by state of residence.

| | MN | WI |
|---|---|---|
| | Percent | |
| Saw/received specific brochure | 61.8 | 16.7 |
| **If so, where brochure was seen** | Percent checking* | |
| Obstetric or OB/GYN doctor's clinic | 78.2 | 46.2 |
| WIC clinic | 20.0 | 33.3 |
| Family doctor's clinic | 22.4 | 10.3 |
| Someplace else | 3.0 | 15.4 |
| Don't recall where I saw or received it | 2.4 | 12.8 |

*Percentages add to more than 100% because brochure could be seen in more than one place.

**Factors Perceived to Influence Fish Consumption When Pregnant and When Not Pregnant**

The Theory of Planned Behavior was used to identify factors influencing women's fish consumption and their adherence to the advice they received. The Theory of Planned Behavior postulates that behaviors are influenced by three interrelated factors: (1) attitude toward the behavior (e.g., Does an individual think engaging in the behavior is good or bad?); (2) perceived behavioral control (e.g., How easy or difficult do individuals think the behavior is?); and (3) subjective norm (e.g., What social pressures exist for individuals to engage in the behavior?). These factors are themselves influenced by beliefs about outcomes of performing the behavior (behavioral beliefs), beliefs about the extent to which the behavior is under their control (control beliefs), and beliefs about how specific people or groups feel about performing the behavior (normative beliefs). This Theory was operationalized in the context of adherence to the fish consumption information they received as outlined in Figure 1, with the general type of questions used shown in each box of the figure and responses generally measured on an agree/disagree scale. Results from path analysis used to test the strength of the relationships when women are and are not pregnant are discussed at the end of this section.

**Behaviors Being Predicted (Behavioral Referent)**

Two behaviors were examined – trying to eat the *types* of fish recommended and trying to eat the *amounts* recommended. A majority of women, regardless of state of residence, indicated that they try to follow the recommendations (for types and amounts) in the information that they received (Table 21). Few disagreed or were unsure. The correlation between these two questions was high (0.791), indicating that women who were trying to follow recommendations

about the types of fish to consume were also trying to follow recommendations about the amounts to consume.

Women with higher levels of education were more likely to indicate that they tried to follow the recommendations than women with less education (Table 22). White women were more likely than non-white women to indicate they tried to eat the amounts of fish recommended (59% vs. 39%).

**Table 21**. Behaviors regarding the consumption of fish recommended by advisory information (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **I try to eat the types of fish recommended in the information I received** | | | | |
| Strongly agree | 24.1 | 26.0 | 23.7 | 23.0 |
| Agree | 41.9 | 40.8 | 44.5 | 37.9 |
| Neutral | 20.3 | 19.5 | 18.5 | 24.8 |
| Disagree | 5.8 | 5.0 | 6.9 | 4.3 |
| Strongly disagree | 3.2 | 3.4 | 2.9 | 3.5 |
| Don't know | 4.7 | 5.3 | 3.5 | 6.5 |
| **I try to eat the amounts of fish recommended in the information I received** | | | | |
| Strongly agree | 20.8 | 20.7 | 21.3 | 19.8 |
| Agree | 36.0 | 39.1 | 37.4 | 30.3 |
| Neutral | 26.5 | 25.3 | 26.4 | 28.0 |
| Disagree | 8.1 | 7.3 | 7.5 | 10.3 |
| Strongly disagree | 3.9 | 3.8 | 3.4 | 4.7 |
| Don't know | 4.7 | 3.8 | 4.0 | 6.9 |

**Table 22.** Behaviors regarding the consumption of fish recommended by advisory information (percent), by education level.

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **I try to eat the types of fish recommended in the information I received** | | | | |
| Education* | | | | |
| HS diploma or less | 42.2 | 35.5 | 10.5 | 11.8 |
| Some college | 59.7 | 21.0 | 13.4 | 5.9 |
| College or graduate degree | 73.5 | 17.0 | 6.7 | 2.8 |
| **I try to eat the amounts of fish recommended in the information I received** | | | | |
| Education* | | | | |
| HS diploma or less | 44.9 | 24.4 | 19.2 | 11.5 |
| Some college | 54.0 | 25.7 | 15.5 | 4.8 |
| College or graduate degree | 60.3 | 27.3 | 9.0 | 3.4 |

*Statically significant difference between groups at $P \leq 0.05$ using chi-square test.

### Behavioral Beliefs and Attitude toward Consumption of Fish

Seven behavioral beliefs and two related attitudes that could influence the behaviors discussed above were examined. These beliefs and attitudes were generally asked in pairs focusing on when women were and were not pregnant. No differences by state of residence were found.

Some have suggested that a reason women don't consume fish, especially during pregnancy, is that fish don't taste good to them. In the three states studied here, this does not appear to be the case for the majority of women (Table 23). About 15% of women said fish did not taste good to them; this percentage was not higher when the women were pregnant.

Three-quarters of women felt that eating fish when they were not pregnant was good for them, but fewer (51%) felt it was good to eat fish for the health of their baby when they were pregnant (Table 23). Almost 80% of women thought that eating some types of fish when they were pregnant was bad for the baby. White women were more likely than non-white women to think eating fish when they were not pregnant was good for them (78% vs. 69%).

Women were less sure of the benefits and risks of fish consumption before pregnancy on the health of their baby. Half thought eating some types of fish was good and one-quarter thought eating some types was bad (Table 23). About one-third were unsure if eating some types of fish was good or bad. Women with a high school diploma or less were more likely to indicate a "don't know" response to all of these beliefs questions (Table 24).

Few women (<20%) thought it was very important to eat fish during pregnancy or when not pregnant (Table 23). About one-third thought it was somewhat important. One-third thought it was not at all important when they were not pregnant; more (38%) thought it was not important during pregnancy. Those with a higher education were somewhat more likely than those with less education to think it was important to eat fish when not pregnant (Table 24).

**Table 23**. Behavioral beliefs and attitudes of new mothers about fish consumption (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Fish did not taste good to me while I was pregnant** | | | | |
| Strongly agree | 7.2 | 8.5 | 5.8 | 8.6 |
| Agree | 7.4 | 7.2 | 8.5 | 5.5 |
| Neutral | 12.2 | 12.3 | 12.5 | 11.7 |
| Disagree | 31.9 | 31.0 | 31.2 | 34.0 |
| Strongly disagree | 29.7 | 29.4 | 30.4 | 28.5 |
| Don't know | 11.6 | 11.6 | 11.6 | 11.7 |
| **Fish does not taste good to me when I am not pregnant** | | | | |
| Strongly agree | 7.5 | 9.5 | 6.3 | 7.8 |
| Agree | 6.1 | 9.2 | 4.5 | 6.1 |
| Neutral | 8.4 | 8.1 | 9.0 | 7.5 |
| Disagree | 33.4 | 32.5 | 31.1 | 39.3 |
| Strongly disagree | 40.0 | 38.0 | 42.8 | 36.2 |
| Don't know | 4.6 | 2.7 | 6.3 | 3.1 |
| **Eating fish when I am pregnant is good for my baby** | | | | |
| Strongly agree | 12.3 | 12.9 | 11.2 | 14.1 |
| Agree | 38.9 | 40.4 | 38.8 | 37.4 |
| Neutral | 27.1 | 27.6 | 27.2 | 26.5 |
| Disagree | 7.4 | 5.1 | 9.4 | 5.5 |
| Strongly disagree | 3.2 | 4.8 | 1.8 | 4.5 |
| Don't know | 11.1 | 9.2 | 11.6 | 12.0 |
| **Eating fish when I am not pregnant is good for me** | | | | |
| Strongly agree | 26.2 | 27.6 | 26.7 | 24.0 |
| Agree | 51.1 | 50.0 | 48.4 | 57.5 |
| Neutral | 13.6 | 15.3 | 14.7 | 9.6 |
| Disagree | 0.7 | 2.0 | 0.0 | 1.0 |
| Strongly disagree | 1.4 | 0.3 | 1.3 | 2.4 |
| Don't know | 7.0 | 4.8 | 8.9 | 5.5 |

Continued on next page

**Table 23** Continued

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Eating some types of fish during pregnancy is bad for my baby** | | | | |
| Strongly agree | 34.7 | 37.5 | 33.5 | 34.5 |
| Agree | 44.1 | 41.5 | 45.4 | 43.7 |
| Neutral | 4.8 | 5.2 | 3.6 | 6.8 |
| Disagree | 4.2 | 5.2 | 4.5 | 2.7 |
| Strongly disagree | 2.6 | 4.1 | 1.8 | 2.7 |
| Don't know | 9.6 | 6.5 | 11.2 | 9.6 |
| **Eating some types of fish before I get pregnant is good for my baby** | | | | |
| Strongly agree | 13.1 | 10.3 | 13.4 | 15.5 |
| Agree | 37.1 | 39.1 | 38.5 | 32.0 |
| Neutral | 18.8 | 20.9 | 16.5 | 21.6 |
| Disagree | 2.9 | 2.7 | 2.2 | 4.5 |
| Strongly disagree | 1.0 | 1.0 | 1.3 | 0.3 |
| Don't know | 27.1 | 26.0 | 28.1 | 26.1 |
| **Eating some types of fish before I get pregnant is bad for my baby** | | | | |
| Strongly agree | 6.4 | 6.2 | 5.8 | 7.9 |
| Agree | 17.7 | 18.9 | 16.5 | 18.9 |
| Neutral | 17.6 | 19.2 | 17.0 | 17.2 |
| Disagree | 19.4 | 18.2 | 21.0 | 17.5 |
| Strongly disagree | 7.3 | 6.9 | 7.6 | 7.2 |
| Don't know | 31.6 | 30.6 | 32.1 | 31.3 |
| **Importance of eating fish during pregnancy** | | | | |
| Very important | 12.1 | 11.5 | 12.4 | 12.0 |
| Somewhat important | 29.3 | 26.8 | 31.6 | 27.0 |
| Slightly important | 20.2 | 21.0 | 19.6 | 20.9 |
| Not at all important | 38.4 | 40.7 | 36.4 | 40.1 |
| **Importance of eating fish when not pregnant** | | | | |
| Very important | 19.7 | 17.2 | 22.2 | 16.8 |
| Somewhat important | 30.8 | 26.7 | 32.5 | 31.5 |
| Slightly important | 18.2 | 19.6 | 16.9 | 19.5 |
| Not at all important | 31.3 | 36.5 | 28.4 | 32.2 |

**Table 24**. Behavioral beliefs and attitudes of new mothers about fish consumption (percent), by education level.

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **Fish did not taste good to me while I was pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 18.8 | 13.3 | 49.1 | 18.8 |
| Some college | 14.2 | 14.6 | 58.6 | 12.6 |
| College or graduate degree | 13.7 | 10.4 | 66.9 | 9.0 |
| **Fish does not taste good to me when I am not pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 20.2 | 7.3 | 64.4 | 8.1 |
| Some college | 12.6 | 12.6 | 70.3 | 4.5 |
| College or graduate degree | 12.1 | 5.8 | 78.4 | 3.7 |
| **Eating fish when I am pregnant is good for my baby** | | | | |
| Education* | | | | |
| HS diploma or less | 40.3 | 24.0 | 13.2 | 22.5 |
| Some college | 46.8 | 28.8 | 12.8 | 11.6 |
| College or graduate degree | 56.6 | 27.2 | 8.7 | 7.5 |
| **Eating fish when I am not pregnant is good for me** | | | | |
| Education* | | | | |
| HS diploma or less | 63.0 | 14.2 | 2.4 | 20.4 |
| Some college | 71.1 | 19.7 | 3.2 | 6.0 |
| College or graduate degree | 84.9 | 10.2 | 1.2 | 3.7 |
| **Eating some types of fish during pregnancy is bad for my baby** | | | | |
| Education* | | | | |
| HS diploma or less | 49.2 | 7.1 | 13.5 | 30.2 |
| Some college | 75.7 | 7.7 | 7.7 | 8.9 |
| College or graduate degree | 89.5 | 2.3 | 4.2 | 4.0 |
| **Eating some types of fish before I get pregnant is good for my baby** | | | | |
| Education* | | | | |
| HS diploma or less | 29.7 | 25.0 | 6.2 | 39.1 |
| Some college | 45.2 | 24.0 | 2.8 | 28.0 |
| College or graduate degree | 58.5 | 14.2 | 4.0 | 23.3 |

Continued on next page

**Table 24** continued

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **Eating some types of fish before I get pregnant is bad for my baby** | | | | |
| Education* | | | | |
| HS diploma or less | 13.4 | 18.1 | 26.8 | 41.7 |
| Some college | 22.3 | 20.2 | 27.1 | 30.4 |
| College or graduate degree | 28.0 | 15.9 | 27.0 | 29.1 |
| | Very important | Somewhat important | Slightly important | Not at all important |
| **Importance to me of eating fish during pregnancy** | | | | |
| Education* | | | | |
| HS diploma or less | 7.9 | 33.4 | 19.0 | 39.7 |
| Some college | 13.3 | 29.7 | 13.7 | 43.3 |
| College or graduate degree | 12.2 | 28.4 | 24.5 | 34.9 |
| **Importance to me of eating fish when not pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 9.5 | 34.1 | 15.1 | 41.3 |
| Some college | 18.0 | 28.0 | 18.0 | 36.0 |
| College or graduate degree | 23.4 | 32.1 | 19.0 | 25.5 |

*Statically significant difference between groups at $P \leq 0.05$ using chi-square test.

### Normative Beliefs and the Subjective Norm

Four normative beliefs and two measures of subjective norms that could influence the behaviors discussed above were examined. Again, these questions were asked in pairs focused on during pregnancy and when not pregnant. There were no differences based on state of residence of the mothers.

Many mothers' female friends and family members ate fish when they were not pregnant, but fewer consumed fish during pregnancy (Table 25). Mothers did not think family and friends held strong views on whether they should eat fish when they were or were not pregnant – one-third were neutral, one-third indicated "don't know." Education level did not influence these views, except that more college-educated women had female friends and family members that ate fish when not pregnant compared to those with less education (Table 26). Non-white women were more likely than white women to think that their family and friends thought it was important that they ate fish during pregnancy (37% vs. 15%) and when they were not pregnant (44% vs. 31%).

Few women want to do what their family and friends think is best when it comes to eating fish, most are neutral or disagree with the statements (Table 25). Those with lower education levels were a bit more likely to want to do what their family and friends thought was best than those with higher education levels, but the differences while statistically significant are so small that they likely do not have meaningful practical implications (Table 26).

**Table 25**. Normative beliefs and the subjective norm related to consumption of fish (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **My family and friends think it is important that I eat fish during pregnancy** | | | | |
| Strongly agree | 4.8 | 6.1 | 4.0 | 5.1 |
| Agree | 12.7 | 10.2 | 13.8 | 13.0 |
| Neutral | 32.1 | 36.8 | 29.3 | 33.4 |
| Disagree | 15.3 | 13.6 | 16.0 | 15.4 |
| Strongly disagree | 7.0 | 6.8 | 6.7 | 7.8 |
| Don't know | 28.1 | 26.5 | 30.2 | 25.3 |
| **My family and friends think it is important that I eat fish when I am not pregnant** | | | | |
| Strongly agree | 8.2 | 8.8 | 8.0 | 7.8 |
| Agree | 24.4 | 18.0 | 28.4 | 22.2 |
| Neutral | 29.5 | 34.1 | 26.7 | 31.4 |
| Disagree | 7.1 | 9.5 | 5.3 | 8.2 |
| Strongly disagree | 3.5 | 4.1 | 2.7 | 4.8 |
| Don't know | 27.3 | 25.5 | 28.9 | 25.6 |
| **Most of my female family members and friends eat fish during pregnancy** | | | | |
| Strongly agree | 5.7 | 7.1 | 5.4 | 4.8 |
| Agree | 27.0 | 24.1 | 26.8 | 30.2 |
| Neutral | 16.5 | 14.6 | 16.5 | 18.5 |
| Disagree | 9.7 | 10.5 | 11.2 | 5.8 |
| Strongly disagree | 4.7 | 4.1 | 5.4 | 4.1 |
| Don't know | 36.4 | 39.6 | 34.7 | 36.6 |
| **Most of my female family members and friends eat fish when they are not pregnant** | | | | |
| Strongly agree | 15.1 | 14.3 | 16.1 | 13.7 |
| Agree | 49.0 | 44.8 | 47.8 | 55.8 |
| Neutral | 9.4 | 12.6 | 8.0 | 8.9 |
| Disagree | 5.8 | 5.8 | 7.1 | 3.1 |
| Strongly disagree | 1.2 | 1.7 | 0.9 | 1.4 |
| Don't know | 19.5 | 20.8 | 20.1 | 17.1 |

Continued on next page

**Table 25** continued

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **When it comes to eating fish during pregnancy, I want to do what my family and friends think is best** | | | | |
| Strongly agree | 3.6 | 4.1 | 3.2 | 4.1 |
| Agree | 13.5 | 9.9 | 16.7 | 10.7 |
| Neutral | 30.5 | 32.0 | 29.6 | 30.6 |
| Disagree | 30.2 | 30.4 | 28.4 | 33.6 |
| Strongly disagree | 15.6 | 18.1 | 14.0 | 16.5 |
| Don't know | 6.6 | 5.5 | 8.1 | 4.5 |
| **When it comes to eating fish when I am not pregnant, I want to do what my family and friends think is best** | | | | |
| Strongly agree | 2.8 | 2.4 | 2.7 | 3.4 |
| Agree | 9.8 | 6.8 | 11.7 | 8.9 |
| Neutral | 32.5 | 32.3 | 33.7 | 29.8 |
| Disagree | 29.6 | 31.8 | 27.5 | 31.9 |
| Strongly disagree | 18.8 | 21.2 | 16.7 | 20.9 |
| Don't know | 6.5 | 5.5 | 7.7 | 5.1 |

**Table 26**. Normative beliefs and the subjective norm related to consumption of fish (percent), by education level.

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **My family and friends think it is important that I eat fish during pregnancy** | | | | |
| Education | | | | |
| HS diploma or less | 20.2 | 26.6 | 26.6 | 26.6 |
| Some college | 17.7 | 30.1 | 21.3 | 30.9 |
| College or graduate degree | 16.2 | 34.9 | 21.8 | 27.1 |
| **My family and friends think it is important that I eat fish when I am not pregnant** | | | | |
| Education | | | | |
| HS diploma or less | 31.5 | 26.0 | 13.4 | 29.1 |
| Some college | 31.2 | 28.0 | 10.8 | 30.0 |
| College or graduate degree | 33.7 | 31.4 | 9.8 | 25.1 |

Continued on next page

**Table 26** continued

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **Most of my female family members and friends eat fish during pregnancy** | | | | |
| Education | | | | |
| HS diploma or less | 28.2 | 19.5 | 14.8 | 37.5 |
| Some college | 29.0 | 17.3 | 16.5 | 37.2 |
| College or graduate degree | 36.0 | 15.3 | 13.0 | 35.7 |
| **Most of my female family members and friends eat fish when they are not pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 46.5 | 15.0 | 10.2 | 28.3 |
| Some college | 60.8 | 12.1 | 7.3 | 19.8 |
| College or graduate degree | 71.2 | 6.0 | 5.8 | 17.0 |
| **When it comes to eating fish during pregnancy, I want to do what my family and friends think is best** | | | | |
| Education* | | | | |
| HS diploma or less | 20.8 | 28.0 | 34.4 | 16.8 |
| Some college | 18.0 | 29.8 | 44.4 | 7.8 |
| College or graduate degree | 15.4 | 31.7 | 50.1 | 2.8 |
| **When it comes to eating fish when I am not pregnant, I want to do what my family and friends think is best** | | | | |
| Education* | | | | |
| HS diploma or less | 11.9 | 35.7 | 35.7 | 16.7 |
| Some college | 13.5 | 31.0 | 49.0 | 6.5 |
| College or graduate degree | 12.1 | 32.4 | 52.0 | 3.5 |

*Statically significant difference between groups at $P \leq 0.05$ using chi-square test.

### Control Beliefs and Perceived Behavioral Control

Four control beliefs and two measures of perceived behavioral control that could influence the behaviors discussed above were examined. Most mothers thought they had received enough information to decide what types of and how much fish to eat during pregnancy (Table 27). The correlation between these two variables was high (0.728), indicating women who knew about types also felt they knew about amounts. This was more likely to be true for Minnesota mothers than mothers in Pennsylvania and Wisconsin, but the differences were not large in magnitude. Better-educated mothers were more likely to feel they had enough information about the types of fish to eat than less-educated mothers (Table 28). White mothers were more likely than non-white mothers to feel they had enough information about the types (81% vs. 72%) and amounts (80% vs. 66%) of fish to eat. Again, socio-demographic differences were not substantial.

Fewer mothers felt they had enough information to decide what types and how much fish to eat when they were not pregnant compared to when they were pregnant (roughly 40% vs. 80%) (Table 27). Minnesota mothers were more likely to feel they had enough information about the types of fish to eat when not pregnant than mothers in Pennsylvania or Wisconsin.

Access to fish was not a limiting factor for 60% of women when they were not pregnant (Table 27). However, when women were pregnant only 42% said access was not a limiting factor. Access was more of a problem for less-educated women than those with a college degree, both when and when not pregnant (Table 28).

**Table 27**. Control beliefs and perceived behavioral control over the consumption of fish (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **I received enough information to decide *what types* of fish to eat during pregnancy*** | | | | |
| Strongly agree | 35.5 | 42.2 | 31.8 | 35.4 |
| Agree | 44.9 | 43.1 | 48.0 | 40.9 |
| Neutral | 8.0 | 8.7 | 7.5 | 8.2 |
| Disagree | 7.6 | 3.0 | 8.1 | 11.6 |
| Strongly disagree | 2.2 | 1.5 | 2.9 | 1.7 |
| Don't know | 1.8 | 1.5 | 1.7 | 2.2 |
| **I received enough information to decide *how much* fish to eat during pregnancy*** | | | | |
| Strongly agree | 31.7 | 39.2 | 27.6 | 31.9 |
| Agree | 47.0 | 45.2 | 50.7 | 41.7 |
| Neutral | 10.1 | 9.9 | 10.3 | 9.9 |
| Disagree | 8.0 | 3.0 | 8.6 | 12.1 |
| Strongly disagree | 1.6 | 0.8 | 1.7 | 2.2 |
| Don't know | 1.6 | 1.9 | 1.1 | 2.2 |
| **I received enough information to decide *what types* of fish to eat when I am not pregnant*** | | | | |
| Strongly agree | 18.2 | 19.9 | 17.8 | 17.2 |
| Agree | 24.9 | 30.9 | 24.1 | 19.8 |
| Neutral | 20.1 | 22.9 | 16.7 | 24.1 |
| Disagree | 23.8 | 16.4 | 26.4 | 26.4 |
| Strongly disagree | 6.5 | 3.8 | 7.5 | 7.3 |
| Don't know | 6.5 | 6.1 | 7.5 | 5.2 |

Continued on next page

**Table 27** continued

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **I received enough information to decide *how much* fish to eat when I am not pregnant** | | | | |
| Strongly agree | 15.9 | 17.5 | 15.0 | 15.9 |
| Agree | 23.1 | 27.7 | 23.1 | 17.7 |
| Neutral | 22.0 | 25.1 | 19.1 | 24.6 |
| Disagree | 24.9 | 18.3 | 27.8 | 26.7 |
| Strongly disagree | 7.1 | 4.6 | 7.5 | 9.1 |
| Don't know | 7.0 | 6.8 | 7.5 | 6.0 |
| **I am able to get as much fish as I want to eat during pregnancy** | | | | |
| Strongly agree | 10.5 | 12.9 | 8.9 | 11.3 |
| Agree | 31.5 | 29.7 | 31.7 | 33.0 |
| Neutral | 15.7 | 16.7 | 13.8 | 18.8 |
| Disagree | 20.3 | 19.0 | 21.9 | 18.1 |
| Strongly disagree | 11.3 | 12.2 | 11.2 | 10.6 |
| Don't know | 10.7 | 9.5 | 12.5 | 8.2 |
| **I am able to get as much fish as I want to eat when I am not pregnant** | | | | |
| Strongly agree | 17.2 | 18.0 | 16.6 | 17.7 |
| Agree | 43.2 | 41.5 | 42.6 | 46.2 |
| Neutral | 16.4 | 19.0 | 13.9 | 19.1 |
| Disagree | 10.5 | 9.9 | 13.0 | 5.8 |
| Strongly disagree | 3.3 | 3.4 | 2.7 | 4.4 |
| Don't know | 9.4 | 8.2 | 11.2 | 6.8 |

*Statically significant differences between states at $P \leq 0.05$ using chi-square test.

**Table 28**. Control beliefs and perceived behavioral control over the consumption of fish (percent), by education level.

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **I received enough information to decide what types of fish to eat during pregnancy** | | | | |
| Education* | | | | |
| HS diploma or less | 74.7 | 7.6 | 10.1 | 7.6 |
| Some college | 75.5 | 12.0 | 10.3 | 2.2 |
| College or graduate degree | 83.3 | 6.4 | 9.8 | 0.5 |

Continued on next page

**Table 28** continued

| | Strongly agree or agree | Neutral | Strongly disagree or disagree | Don't know |
|---|---|---|---|---|
| **I received enough information to decide how much fish to eat during pregnancy** | | | | |
| Education* | | | | |
| HS diploma or less | 78.3 | 3.8 | 12.8 | 5.1 |
| Some college | 79.0 | 9.7 | 9.7 | 1.6 |
| College or graduate degree | 78.7 | 11.8 | 8.7 | 0.8 |
| **I received enough information to decide what types of fish to eat when I am not pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 41.0 | 15.4 | 26.9 | 16.7 |
| Some college | 50.0 | 14.5 | 25.3 | 10.2 |
| College or graduate degree | 40.1 | 24.2 | 32.9 | 2.8 |
| **I received enough information to decide how much fish to eat when I am not pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 40.8 | 15.8 | 27.6 | 15.8 |
| Some college | 43.8 | 15.5 | 28.9 | 11.8 |
| College or graduate degree | 36.0 | 26.7 | 34.2 | 3.1 |
| **I am able to get as much fish as I want to eat during pregnancy** | | | | |
| Education* | | | | |
| HS diploma or less | 36.7 | 14.1 | 28.1 | 21.1 |
| Some college | 35.6 | 17.0 | 34.0 | 13.4 |
| College or graduate degree | 47.4 | 15.6 | 30.7 | 6.3 |
| **I am able to get as much fish as I want to eat when I am not pregnant** | | | | |
| Education* | | | | |
| HS diploma or less | 47.6 | 17.5 | 15.1 | 19.8 |
| Some college | 54.8 | 19.0 | 14.9 | 11.3 |
| College or graduate degree | 67.7 | 14.4 | 12.6 | 5.3 |

*Statically significant difference between groups at $P \leq 0.05$ using chi-square test.

### Relationships between the Factors and the Behaviors

The Theory of Planned Behavior, in brief, suggests that beliefs influence attitudes, which in turn influence behavior. We examined this for the set of beliefs and attitudes associated with fish consumption during pregnancy (Fig. 3) and then separately for those associated with consumption when not pregnant (Fig. 4). The results were similar enough that they will be discussed together here. Of the behavioral beliefs examined, the belief that eating fish when I am pregnant is good for my baby was the most highly correlated with the attitude – importance of eating fish during pregnancy (Fig. 3), and the belief that eating fish when I am not pregnant is good for me was the most highly correlated with the importance of eating fish when not pregnant (Fig. 4). For example in Figure 3, the results of path analysis showed that mothers who think eating fish is good for their baby also think it is important to eat fish during pregnancy. Also correlated with the importance of eating fish was the idea that eating some types of fish before becoming pregnant was good for the baby. Negatively correlated was taste and importance (i.e., if fish tasted bad then they didn't think it was important to eat it, especially when they were not pregnant).

Of the normative beliefs examined, the mothers' belief that most of their female family members and friends eat fish was very highly correlated with the subjective norm, what they think their family and friends think they should do (Figs. 3 and 4). If female family and friends eat fish, the understanding on the part of the mother appears to be that her family and friends think she should eat fish.

The relationship between mothers' control beliefs about receiving enough information to make decisions and their access to fish appears limited (Figs. 3 and 4).

The two behaviors that were predicted from the attitudes and beliefs discussed above were trying to eat the *types* and *amounts* of fish recommended in the information received. Both were significantly related to the attitude and subjective norm measures, but the importance of eating fish was more strongly correlated (Figs. 3 and 4). The measure of access to fish appears to have little or no relationship to the behaviors.

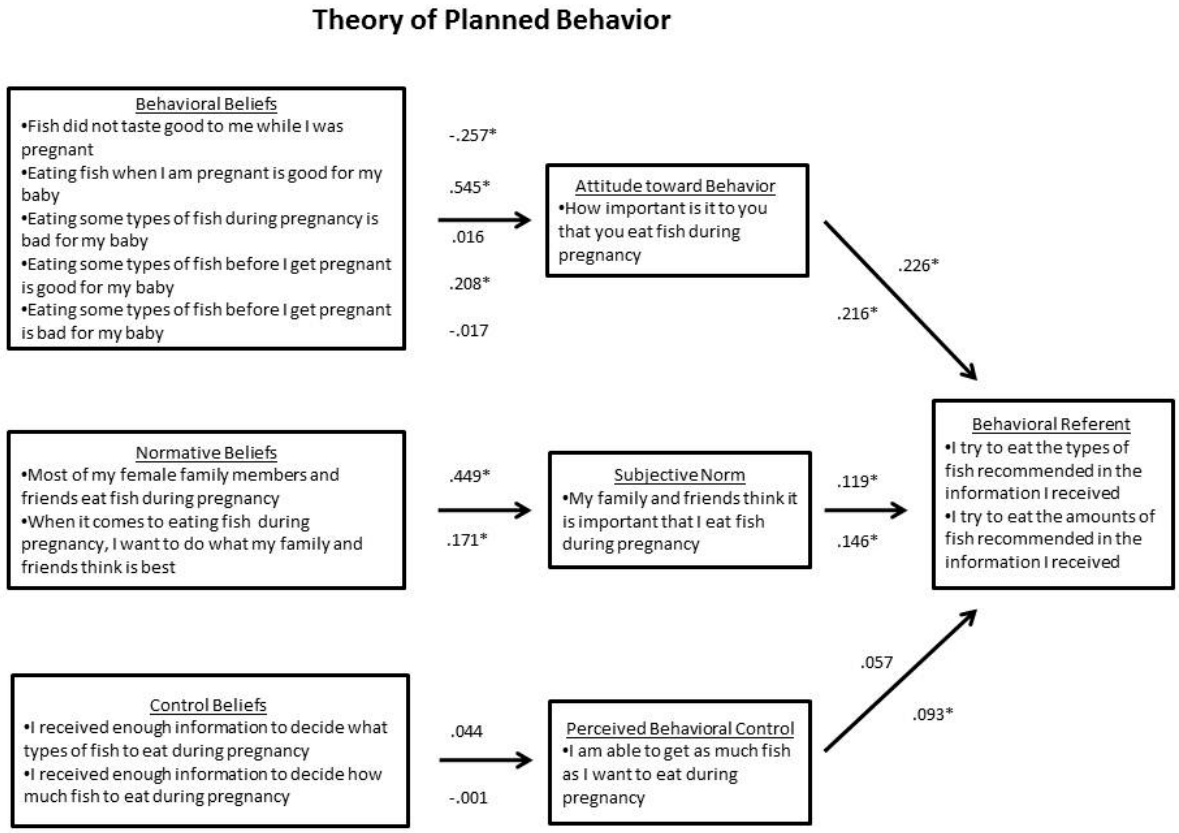



**Figure 3**. Path diagram showing the use of the Theory of Planned Behavior as it applies to women's adherence to the fish consumption recommendations during pregnancy, with standardized regression coefficients from an ordinary least squares regression. (Asterisks indicate significant values at P=0.05.)

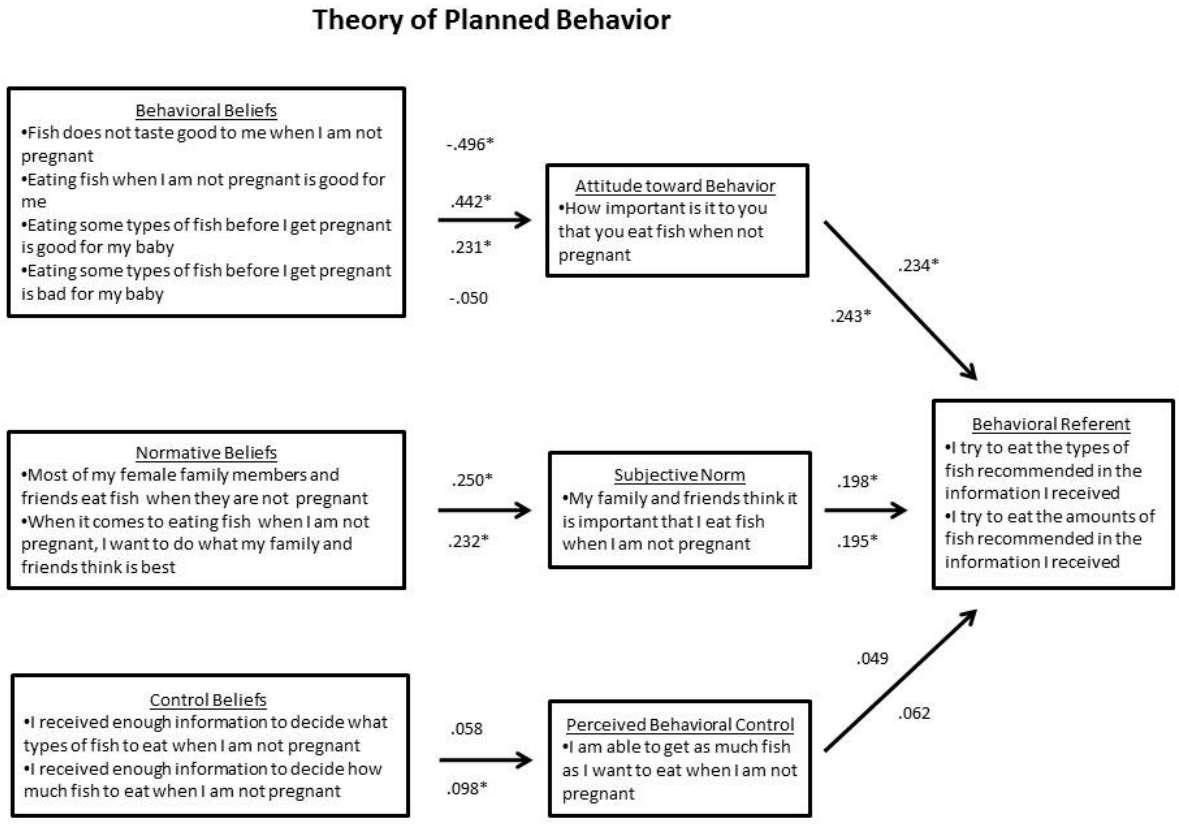



**Figure 4**. Path diagram showing the use of the Theory of Planned Behavior as it applies to women's adherence to the fish consumption recommendations when not pregnant, with standardized regression coefficients from an ordinary least squares regression. (Asterisks indicate significant values at P=0.05.)

**Meaning of the Term "Women of Child-bearing Age"**

Respondents were asked what age range do they think of when they hear the phrase, "females who might become pregnant," because agencies want to be sure that if they do not specify an age range when providing advice to this group that all members of the group will perceive they are included. Thirteen percent of respondents suggested a beginning age under 15 years old, but the majority (74%) indicated 15-20 years old, with a few (13%) suggesting an age older than 20. For the top end of the range a few people (12%) gave an age under 35 years old, 30% said 35 – 39 years old, 35% said 40-44 years old, 17% said 45-49 years old, 4% said 50 years old, and a few (2%) gave an age over 50. It seems a range of 15 years old (covering 87% of respondents) to 45 years old (covering 92% of respondents) or 50 years old (covering 98% of respondents) would include the ages most women think of as a time when women could become pregnant. There were no differences between states.

When organizations are giving advice to women of child-bearing age they refer to the group using a variety of terms. Respondents to this study thought the descriptor "women who are or

could some day become pregnant" was the best term for describing the group (Table 29). "Women" rather than "females" was preferred by a majority of respondents, as was "who are or could some day become pregnant" versus "child-bearing age." Simply providing an age range did not appear to describe the group for most respondents. There were no differences between states.

**Table 29.** Mothers' opinions on the best descriptor for the group of women commonly referenced for special advice in the fish consumption advisories (percent).

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Best descriptor** | | | | |
| Women who are or could some day become pregnant | 35.4 | 36.6 | 35.2 | 34.5 |
| Women of child-bearing age | 22.1 | 21.6 | 23.5 | 19.5 |
| Females who are or could some day become pregnant | 18.4 | 18.1 | 18.1 | 19.2 |
| Females between the age of 15 and 50 | 12.8 | 13.1 | 11.3 | 15.7 |
| Females of child-bearing age | 10.5 | 9.2 | 10.9 | 11.1 |
| Other suggestions | 0.8 | 1.4 | 0.9 | 0.0 |

## DISCUSSION AND RECOMMENDATIONS

The Great Lakes Consortium for Fish Consumption Advisories is working together to enhance state fish consumption advisory programs by determining how to communicate information to the public more effectively, thereby increasing public knowledge about the risks and benefits of fish consumption and reducing public exposure to toxic substances from consumption of contaminated fish. A primary audience for communication is women of child-bearing age. Based on our analysis we have made some recommendations for agencies to help improve communication to this audience. We have organized our discussion and recommendations below based on the objectives for this survey, which were to:

1. Assess fish consumption behaviors (before, during, and after pregnancy);
2. Identify the most important factors influencing those behaviors;
3. Assess awareness and general knowledge of fish consumption recommendations for women of child-bearing age;
4. Assess use of information sources for fish consumption recommendations; and
5. Assess understanding of terms describing "women of child-bearing age."

After discussing recommendations for agencies, we will make a few recommendations for future research.

**Discussion and Recommendations for Agencies**

Most women (84%) are consuming at least some fish during pregnancy. This finding is similar to the two earlier studies in Wisconsin and Minnesota, which found that 87% of Minnesota new mothers (MDH 2012) and 88% of Wisconsin new mothers (Gliori et al. 2006) consumed at least one meal in the past 12 months (that covered the period during pregnancy, but also included some time after giving birth). The amount and types of fish consumed appear similar as well. The earlier studies estimated consumption at 2.6 meals per month in Minnesota and 3 meals per month in Wisconsin; we found that 43% ate 1 to 3 meals per month during pregnancy. The most commonly consumed fish in all studies were canned tuna and shellfish. Most women in our study did not identify the taste of fish as being a deterrent to their consumption during pregnancy. The advisory recommendation to eat at least some fish during pregnancy seems to be heeded by most women. However, the amount of fish eaten is well below the levels recommended for almost all of the women. The remainder of this section provides recommendations for agencies, based on the results from this study.

Increase emphasis on eating at least some low-risk fish during pregnancy. It appears that many women are changing their behavior and consuming less fish in general during pregnancy than before. This was true for consumption by species groups as well. The percent of women consuming each species group decreased during pregnancy compared to before pregnancy. The study in Maine found some evidence of switching between consumption of canned "white" tuna to less-contaminated canned "light" tuna (Teisl et al. 2011). While that might have happened among the women in our study, the predominant trend was a decrease in consumption of all types of fish. For example, the percent of women who ate sport-caught fish dropped by half during pregnancy compared to before pregnancy. Our recommendation would be to try to change this behavior by focusing messages on eating healthy fish and describing why it is important to eat healthy fish during pregnancy.

Increase emphasis on eating low-risk fish after pregnancy. After giving birth, women's consumption remained the same or increased a little. Again, communicating with women about the benefits of consuming of less-contaminated fish, even while breastfeeding is important.

High-risk commercial species do not require additional emphasis. Consumption of fish that most organizations recommend against eating seems to be very low (i.e., shark, swordfish, tilefish, or king mackerel). Either through awareness from the advisories or lack of access to these species, it appears that agencies need not be concerned about women of child-bearing age having too much exposure to chemical contaminants from these specific species.

Increase availability of fish consumption information for women prior to pregnancy. Half to two-thirds of women had not received information about fish consumption prior to getting pregnant. If a goal of agencies is to make women aware of recommendations before pregnancy, then communication methods in addition to the OB/GYN offices (a primary source during pregnancy) likely will be needed. Perhaps materials at family practice offices or other means of mass media communication will be needed, particularly for those who may not have regular access to medical care.

Continue targeting information to pregnant women; increase emphasis on eating more less-contaminated fish while pregnant. Women received information primarily during pregnancy about the types of fish and how much fish to eat. Most women who consumed fish during pregnancy had received information about the types and amounts of fish to eat during or prior to becoming pregnant. This was true for both sport-caught and purchased fish consumption. The three sources of information used most frequently (health care providers, web sites, and health information brochures) were seen by two-thirds of the mothers as being very useful. Most mothers felt they had received enough information to decide what types and how much fish to eat during pregnancy. Awareness and access to information that women find useful is not a concern to be addressed during pregnancy for most women, but rather we suggest that agencies keep doing what they are doing. For example, Minnesota mothers were much more likely than Wisconsin or Pennsylvania mothers to get information from their health care providers or from health information brochures. Pennsylvania mothers, and to a slightly lesser extent Wisconsin mothers, were more likely to access web sites for information than mothers in Minnesota. These most likely reflect the different emphasis each state places on the methods of communication.

Many women are changing their behavior and consuming less fish during pregnancy than before they were pregnant. The women who had received information during their pregnancy were more likely to have decreased their consumption. Those who had not received information during pregnancy were more likely to either eat the same amount during pregnancy as before, or not eat fish to begin with. If the decrease was caused by the message, which seems likely, but cannot be proven using our data, then it appears to be the message, rather than the communication method, that needs to change in order to encourage women to eat more of the less-contaminated species.

Targeted communication methods and messages are needed to reach less-educated women. Women with lower education levels ate less fish, were less likely to have received information about fish consumption, were less knowledgeable, and were less likely to try to follow the recommendations. Access to fish was more of a problem for less-educated women than those with a college degree, both when and when not pregnant. Communication with this group should focus on providing information to increase basic knowledge, but also informing/changing beliefs that consumption of less contaminated fish is good for their health and the health of their baby. Women in this group are less likely to seek out information, so methods of communication must focus on putting information where they are likely to see it. Our study findings also indicate that this group is more likely to contain Hispanic women and thus any materials produced for this group might be produced in Spanish as well as English.

Use the terminology of "women who are or could some day become pregnant" instead of "women of child-bearing age." When organizations are giving advice to women of child-bearing age they refer to the group using a variety of terms. Respondents to this study thought the descriptor "women who are or could some day become pregnant" was the best term for describing the group. Simply providing an age range did not appear to describe the group for most respondents. If states wanted to clarify (further describe) by giving an age range, it seems a range of 15 years old (covering 87% of respondents) to 45 years old (covering 92% of respondents) or 50 years old (covering 98% of respondents) would include the ages most women think of as a time when women could become pregnant.

Explain more clearly advice regarding sport-caught fish; don't assume women know sport-caught fish concepts. Women knew the correct answer to some of the knowledge questions, particularly that children's health can be harmed more than adults, and that chemical contaminants build up over time, but in many cases they indicated they "didn't know." The items that they didn't know about are more often currently associated with advice for sport-caught fish (i.e., older fish, bigger fish, fish that eat other fish have more contaminants), so increasing knowledge for this part of the message, while important for all women, may be especially important for women eating sport-caught fish because many of them didn't know the answers either. Anglers tend to be more knowledgeable about these items already (Connelly et al. 2012). In the case of the knowledge question concerning the level of contaminants in fish that eat other fish versus fish that eat other things, this message by itself will not be effective because most women indicated they do not know which fish eat other fish. Only 15% of mothers said they knew which fish eat other fish, so it would be difficult for them to follow the advice of eating fish that do not eat other fish.

Continue including information about contaminants and how they vary in fish tissue. As in the earlier studies of Wisconsin and Minnesota new mothers (Gliori et al. 2006, MDH no date), most women did not know that mercury is found in the meat/flesh and not just in the fat, as is the case with other contaminants such as PCBs (4% vs. 10% in WI and MN). Although the wording of the questions was not identical between the earlier studies and the current study, it seems that the proportion of new mothers who knew that older fish tend to have higher levels of contaminants than younger fish, and that fish that eat other fish have higher levels than fish that eat other things is increasing (older fish – 33% WI, 40% MN, 43% current study, predatory fish – 22% WI, 25% MN, 32% current study). Perhaps current messages on these topics are reaching more women over time as more materials are distributed.

Clarify importance of eating fish before, during, and after pregnancy. A majority of women indicated that they try to follow the recommendations (for types and amounts) in the information that they received, and some of their beliefs support that assertion. For example, three-quarters of women felt that eating fish when they were not pregnant was good for them, but fewer (51%) felt it was good to eat fish for the health of their baby when they were pregnant. Almost 80% of women thought that eating some types of fish when they were pregnant was bad for the baby, but women were less sure of the benefits and risks of fish consumption before pregnancy on the health of their baby. Half thought eating some types of fish was good and one-quarter thought eating some types was bad. About one-third were unsure if eating some types of fish was good or bad. So clarification is needed about which fish are good to eat and why.

In general, few women (<20%) thought it was very important to eat fish during pregnancy or when not pregnant. About one-third thought it was somewhat important. One-third thought it was not at all important when they were not pregnant; more (38%) thought it was not important during pregnancy. So while they try to follow the recommendations, many didn't think it was very important to eat fish, so more needs to be done to raise the "importance level."

Emphasizing normative beliefs in health advisories is likely unnecessary for most women to stimulate desired fish consumption behaviors. Mothers did not think family and friends held

strong views on whether they should eat fish when they were or were not pregnant – one-third were neutral, one-third indicated "don't know." Many mothers' female friends and family members ate fish when they were not pregnant, but fewer consumed fish during pregnancy. Our analysis suggests that these normative beliefs are not that strong of an influence on women's behavior. However, non-white women were more likely than white women to think that their family and friends thought it was important that they ate fish during pregnancy (37% vs. 15%) and when they were not pregnant (44% vs. 31%). This suggests that communication methods that involve social networks might be effective in reaching this group. Also non-white women are less likely to seek out information than white women, so methods of communication should focus on putting information where they are likely to see it.

Health advisories need not emphasize control beliefs. Access to fish was not a limiting factor for 60% of women when they were not pregnant. However, when women were pregnant only 42% said access was not a limiting factor. This difference could be indicating women weren't sure what fish were safe to eat during pregnancy (i.e., they didn't have access to "safe" fish) or that "safer" fish were more expensive, harder to find, etc. Still most women were able to get as much fish as they wanted to eat.

The most important health advisory messages appear to be that eating fish is good for you and for your baby, that it is important to eat fish, and that it is important to follow health advisory recommendations. In summary, from our examination of factors influencing women to try to follow the recommendations on fish consumption, the strongest connection was from believing that eating fish was good for you and your baby, to thinking it is important to eat fish, to trying to follow the recommendations. What other people think or do is less important, and access is not generally a constraint. Focusing future messages on the most important factors is most likely to change behavior.

**Discussion and Recommendations for Research**

The response rate to this survey was much lower than the earlier surveys with the same audience (women who recently gave birth) in Wisconsin and Minnesota (30% vs. 73% in MN, 74% in WI) (Gliori et al. 2006, MDH 2012). This was most likely due to the difference in length of the surveys, with the earlier surveys being significantly shorter. The current survey is similar in length to other surveys conducted by our research group, which have resulted in similar response rates. The incentive experiment where half of the sample was given a $2 bill in the first mailing resulted in an approximately 10% higher response rate for the sample receiving the incentive compared with the sample not receiving the incentive. If financially feasible we recommend using a cash incentive to increase response rates in in future surveys of this length.

Respondents did not appear to have any trouble answering any of the questions. There were no questions with a high item non-response. Therefore, we recommend them for use in future surveys.

Future research could focus on message testing to see what messages would increase women's consumption of less-contaminated fish during pregnancy. Current messages seem related to women decreasing their consumption of all types of fish during pregnancy, even though women

say they are trying to follow the recommendations. Work by Teisl et al (2011) reported some evidence of switching behavior (changing from more to less contaminated fish), but more needs to be done.

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## APPENDIX A

Study Questionnaire

# Health and Nutrition among Minnesota Moms

MINNESOTA MDH DEPARTMENT OF HEALTH

and

Cornell University
Human Dimensions Research Unit

**Health and Nutrition among Minnesota Moms**

Research conducted for the Minnesota Department of Health
by the
Human Dimensions Research Unit
Department of Natural Resources
Cornell University

We would like to know about your fish eating and if this changed before, during, or after your pregnancy. This type of information will help us to better serve the health and nutritional needs of mothers in Minnesota.

Please complete this questionnaire as soon as you can, seal it with the white re-sealable label provided, and drop it in any mailbox; return postage has been paid. We are interested in learning about your experiences and opinions. Your participation in this survey is voluntary, but we sincerely hope you will take just a few minutes to answer our questions. Your identity will be kept confidential and the information you give us will never be associated with your name.

**THANK YOU FOR YOUR HELP!**

1. **During pregnancy, about how many meals of fish or shellfish (including fresh, canned, smoked or frozen) did you eat? Include all fish caught by yourself or someone you know or bought at a store or restaurant.**

   ☐ None
   ☐ Less than 1 meal per month
   ☐ 1 to 3 meals per month
   ☐ At least 1 meal per week
   ☐ At least 2 meals per week
   ☐ 3 or more meals per week
   ☐ Don't Know

2. **Did you eat any of the following types of fish and shellfish before, during, or after your most recent pregnancy?** *(Check all that apply. If you did not eat any fish during a particular period, check "I did not eat any fish" in the appropriate column.)*

| I ate: | Before pregnancy | During pregnancy | After I gave birth |
|---|---|---|---|
| Shellfish (shrimp, crab, scallops, etc.) | ☐ | ☐ | ☐ |
| Canned "light" tuna | ☐ | ☐ | ☐ |
| Canned "white" tuna (albacore) | ☐ | ☐ | ☐ |
| Tuna (not canned), halibut, orange roughy, or Chilean seabass | ☐ | ☐ | ☐ |
| Shark, swordfish, tilefish, or king mackerel | ☐ | ☐ | ☐ |
| Salmon purchased at a store or restaurant | ☐ | ☐ | ☐ |
| Other fish purchased at a store or restaurant (not listed above) | ☐ | ☐ | ☐ |
| Fish caught by me or someone I know | ☐ | ☐ | ☐ |
| **I did not eat any fish** | ☐ | ☐ | ☐ |

3. **During pregnancy, did you change the amount of fish or shellfish that you ate compared to before you became pregnant?** *(Check one.)*

   ☐ I did not eat fish (or shellfish) before or during pregnancy
   ☐ I ate a lot more fish or shellfish while I was pregnant
   ☐ I ate a little more fish or shellfish while I was pregnant
   ☐ I ate the same amount of fish or shellfish while I was pregnant
   ☐ I ate a little less fish or shellfish while I was pregnant
   ☐ I ate a lot less fish or shellfish while I was pregnant
   ☐ I stopped eating fish or shellfish while I was pregnant

4. **After your baby was born, did you change the amount of fish or shellfish you ate compared to when you were pregnant?** *(Check one.)*

   ☐ I did not eat fish (or shellfish) during or after pregnancy
   ☐ I now eat a lot more fish or shellfish
   ☐ I now eat a little more fish or shellfish
   ☐ I now eat the same amount of fish or shellfish
   ☐ I now eat a little less fish or shellfish
   ☐ I now eat a lot less fish or shellfish
   ☐ I stopped eating fish or shellfish after my baby was born

**5a. Before getting this survey, had you ever received information about what kinds of fish to eat and how much to eat for your health and the health of your baby?**

**This information may have come from a health care provider, a brochure, a website, or other sources.**

**I received information about eating:** *(Check all that apply.)*

| | Before I became pregnant | During pregnancy | After giving birth | Never got information |
|---|---|---|---|---|
| a. Fish caught by me or someone I know | ☐ | ☐ | ☐ | ☐ |
| b. Fish bought at a store or restaurant | ☐ | ☐ | ☐ | ☐ |

**IF YOU NEVER GOT INFORMATION FOR EITHER TYPE OF FISH, PLEASE SKIP TO QUESTION 9.**

**5b. How did you get this information?** *(Check all that apply.)*

☐ I looked or asked for information about eating fish

☐ Someone gave me information

☐ I just happened to come across information

**5c. Where did you get information about eating fish for your health or your baby's health, and how useful has it been in helping you make decisions about eating fish?**

| Information Sources | Did you get information from this source? *(Check all that apply.)* | Usefulness of information *(Choose one)* | | |
|---|---|---|---|---|
| | | Not at all Useful | Somewhat Useful | Very Useful |
| Newspaper articles | ☐ | ☐ | ☐ | ☐ |
| Television or radio reports | ☐ | ☐ | ☐ | ☐ |
| Web sites | ☐ | ☐ | ☐ | ☐ |
| Health information brochures | ☐ | ☐ | ☐ | ☐ |
| Wallet-sized cards | ☐ | ☐ | ☐ | ☐ |
| My health care providers | ☐ | ☐ | ☐ | ☐ |
| Friends or family | ☐ | ☐ | ☐ | ☐ |
| iPhone/Smartphone apps | ☐ | ☐ | ☐ | ☐ |
| Fishing regulations guide | ☐ | ☐ | ☐ | ☐ |
| Other (please specify): | ☐ | ☐ | ☐ | ☐ |

6. **Have you ever seen or received this brochure?**

- ☐ No -> SKIP TO QUESTION 8
- ☐ Yes


7. **Where did you see or get this brochure?** *(Check all that apply.)*

- ☐ Family doctor's clinic
- ☐ Obstetric or OB/GYN doctor's clinic
- ☐ WIC clinic
- ☐ Someplace else (Please specify: _____)
- ☐ I don't recall where I saw or received it

8. **How strongly do you agree or disagree with the following statements?** *(Check one box for each statement.)*

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't know |
|---|---|---|---|---|---|---|
| I received enough information to decide what types of fish to eat *during pregnancy* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I received enough information to decide how much fish to eat *during pregnancy* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I received enough information to decide what types of fish to eat *when I am not pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I received enough information to decide how much fish to eat *when I am not pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I try to eat the types of fish recommended in the information I received | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I try to eat the amounts of fish recommended in the information I received | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

9. **How important is it to you that you eat fish during pregnancy?** *(Circle one.)*

Very Important | Somewhat Important | Slightly Important | Not at all Important

10. **How important is it to you that you eat fish when not pregnant?** *(Circle one.)*

Very Important | Somewhat Important | Slightly Important | Not at all Important

11. **How strongly do you agree or disagree with the following statements?** *(Check one box for each statement.)*

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't know |
|---|---|---|---|---|---|---|
| Fish did not taste good to me *while I was pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fish does not taste good to me *when I am not pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Eating fish when I am pregnant is good for my baby | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Eating fish when I am not pregnant is good for me | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| My family and friends think it is important that I eat fish *during pregnancy* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| My family and friends think it is important that I eat fish *when I am not pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am able to get as much fish as I want to eat *during pregnancy* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am able to get as much fish as I want to eat *when I am not pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Most of my female family members and friends eat fish *during pregnancy* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't know |
|---|---|---|---|---|---|---|
| Most of my female family members and friends eat fish *when they are not pregnant* | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Eating some types of fish *during pregnancy* is bad for my baby | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Eating some types of fish *before I get pregnant* is good for my baby | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Eating some types of fish *before I get pregnant* is bad for my baby | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| When it comes to eating fish *during pregnancy*, I want to do what my family and friends think is best | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| When it comes to eating fish *when I am not pregnant*, I want to do what my family and friends think is best | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**12. When you hear the phrase "females who might become pregnant," what age range do you think of?**

From _____ To _____

**13. There is advice about eating fish for females who are or could some day become pregnant. In your opinion, which of the phrases below best describes the group underlined above?** *(Check one.)*

- ☐ Women of child-bearing age
- ☐ Females of child-bearing age
- ☐ Females between the age of 15 and 50
- ☐ Women who are or could some day become pregnant
- ☐ Other suggestion: _____
- ☐ Underlined phrase listed above is best

**14. How strongly do you agree or disagree with the following statements?** *(Check one box for each statement.)*

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't know |
|---|---|---|---|---|---|---|
| Some chemical contaminants from eating fish build up in my body over time | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Older fish generally have more chemical contaminants in them than younger fish | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Most of the mercury is found in the fat of fish | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fish that eat other fish tend to have more chemical contaminants than fish that eat other things | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I know which fish eat other fish and which fish eat other things | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Smaller fish generally have more chemical contaminants in them than larger fish | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Children's health can be harmed more than adult's health by chemical contaminants in fish | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fish from lakes outside the metro area are safer to eat than fish from lakes inside the metro area | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

## BACKGROUND INFORMATION

**15. In what year were you born?** 19_____

**16. Was your most recent pregnancy your first?**

- ☐ No
- ☐ Yes

**17. Did you breastfeed after your most recent pregnancy?**

- ☐ No
- ☐ Yes

**18. Have you or anyone in your household gone fishing in the past 12 months?** *(Check all that apply.)*

- ☐ I have gone fishing
- ☐ Other household members have gone fishing
- ☐ No one in my household has gone fishing in the past 12 months

**19. What is the highest level of education you have completed?** *(Check one.)*

- ☐ Less than high school
- ☐ High school diploma / G.E.D.
- ☐ Some college or technical school
- ☐ Associate's degree
- ☐ College undergraduate degree (e.g., B.A., B.S.)
- ☐ Graduate or professional degree (e.g., M.S., Ph.D., M.D., J.D.)

**20. What was the total income of your household before taxes last year?** *(Check one.)*

- ☐ Less than $25,000
- ☐ $25,000 to $49,999
- ☐ $50,000 to $74,999
- ☐ $75,000 to $99,999
- ☐ $100,000 or more

**21. Are you of Hispanic, Latino, or Spanish origin?**

☐ No ☐ Yes

**22. What is your race?** *(Check all that apply.)*

- ☐ White
- ☐ Black or African-American
- ☐ Asian or Pacific Islander
- ☐ Native American Indian
- ☐ Other

## Thank you for your time and effort!

To return this questionnaire, simply seal it with the white removable seal, and drop it in the mail (return postage has been paid).

Hold for back cover with business reply

## APPENDIX B

Assessment of Non-response Bias

**Table B1**. Age

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Mean | n | Mean | n |
| Age | 29.6 | 617 | 28.9 | 128 |

NS

**Table B2**. Fish meals eaten during pregnancy.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| None | 16.8 | 103 | 24.8 | 32 |
| Less than 1 meal per month | 23.9 | 147 | 26.4 | 34 |
| 1 to 3 meals per month | 42.3 | 260 | 26.4 | 34 |
| At least 1 meal per week | 12.9 | 79 | 15.5 | 20 |
| At least 2 meals per week | 3.4 | 21 | 5.4 | 7 |
| 3 or more meals per week | 0.5 | 3 | 1.6 | 2 |
| Don't know | 0.2 | 1 | 0.8 | 1 |

($\underline{x}^2 = 12.9$, df=3, P=0.005)

**Table B3**. Changes in amount of fish meals eaten compared to before pregnancy.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| Did not eat fish or shellfish before or during pregnancy | 12.3 | 71 | 14.6 | 19 |
| Ate more fish or shellfish during pregnancy | 7.7 | 44 | 4.6 | 6 |
| Ate the same amount of fish or shellfish during pregnancy as before | 31.7 | 183 | 51.5 | 67 |
| Ate less fish or shellfish during pregnancy | 40.6 | 234 | 23.8 | 31 |
| Stopped eating fish or shellfish during pregnancy | 7.8 | 45 | 5.4 | 7 |

($\underline{x}^2 = 22.3$, df=4, P<0.001)

**Table B4**. Changes in amount of fish meals eaten compared to during pregnancy.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| Did not eat fish or shellfish during or after pregnancy | 13.5 | 78 | 14.6 | 19 |
| Eat more fish or shellfish since pregnancy | 25.9 | 150 | 16.9 | 22 |
| Eat the same amount of fish or shellfish after pregnancy as during | 45.5 | 263 | 58.5 | 76 |
| Eat less fish or shellfish since pregnancy | 11.2 | 65 | 7.7 | 10 |
| Stopped eating fish or shellfish after pregnancy | 3.8 | 22 | 2.3 | 3 |
| | NS | | | |

**Table B5**. Receipt of information of what kinds and how much fish to eat for health and health of baby.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| Received information on eating fish caught by me or someone I know | | | | |
| Yes | 72.2 | 413 | 76.7 | 99 |
| No | 27.8 | 159 | 23.3 | 30 |
| | NS | | | |
| Received information on eating fish bought at a store or restaurant | | | | |
| Yes | 81.3 | 465 | 65.9 | 85 |
| No | 18.7 | 107 | 34.1 | 44 |
| | ($\underline{x}^2$ = 14.8, df=1, P<0.001) | | | |

**Table B6**. Received enough information to decide what types of fish to eat during pregnancy.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| Strongly agree | 39.0 | 193 | 31.8 | 34 |
| Agree | 42.0 | 208 | 56.1 | 60 |
| Neutral | 8.5 | 42 | 7.5 | 8 |
| Disagree | 7.1 | 35 | 4.7 | 5 |
| Strongly disagree | 1.6 | 8 | 0 | 0 |
| Don’t Know | 1.8 | 9 | 0 | 0 |
| | NS | | | |

**Table B7**. Received enough information to decide how much fish to eat during pregnancy.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| Strongly agree | 35.8 | 177 | 28.0 | 30 |
| Agree | 43.6 | 216 | 58.9 | 63 |
| Neutral | 9.9 | 49 | 9.3 | 10 |
| Disagree | 7.3 | 36 | 3.7 | 4 |
| Strongly disagree | 1.4 | 7 | 0 | 0 |
| Don't Know | 2.0 | 10 | 0 | 0 |

($x^2$=8.6, df=3, P=0.036)

**Table B8**. Eating fish when I'm pregnant is good for my baby.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| Strongly agree | 13.5 | 79 | 5.7 | 7 |
| Agree | 39.0 | 228 | 47.2 | 58 |
| Neutral | 27.0 | 158 | 32.5 | 40 |
| Disagree | 5.3 | 31 | 13.0 | 16 |
| Strongly disagree | 4.6 | 27 | 1.6 | 2 |
| Don't Know | 10.6 | 62 | 4.6 | 6 |

($x^2$=12.8, df=4, P=0.012)

**Table B9**. Household fishing habits last 12 months.

| | Respondents | | Non-respondents | |
|---|---|---|---|---|
| | Percent | n | Percent | n |
| I have gone fishing in last 12 months | | | | |
| Yes | 24.1 | 149 | 33.8 | 44 |
| No | 75.9 | 468 | 66.2 | 86 |
| | ($x^2$=5.3, df=1, P=0.022) | | | |
| Other household members have gone fishing in last 12 months | | | | |
| Yes | 44.9 | 277 | 53.1 | 69 |
| No | 55.1 | 340 | 46.9 | 61 |
| | NS | | | |

## APPENDIX C

Supplemental Tables

**Table C-1.** Types of fish eaten by new mothers with a high school diploma or less before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 18.0 | 22.6 | 22.6 |
| Sport-caught fish | 12.8 | 6.0 | 4.5 |
| Shellfish | 49.3 | 42.1 | 33.1 |
| Canned “light” tuna | 49.3 | 40.3 | 37.6 |
| Caned “white” tuna (albacore) | 28.4 | 27.1 | 21.6 |
| Salmon | 20.1 | 18.8 | 12.7 |
| Tuna, halibut, orange roughy or Chilean seabass | 6.0 | 4.5 | 3.8 |
| Shark, swordfish, tilefish or king mackerel | 0.7 | 0.0 | 0.0 |
| Other purchased fish | 33.1 | 32.1 | 28.6 |

**Table C-2.** Types of fish eaten by new mothers with some college education before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 11.3 | 16.7 | 13.2 |
| Sport-caught fish | 30.7 | 11.3 | 12.1 |
| Shellfish | 63.4 | 54.9 | 48.2 |
| Canned “light” tuna | 52.5 | 38.9 | 35.4 |
| Caned “white” tuna (albacore) | 39.3 | 27.2 | 28.0 |
| Salmon | 36.2 | 28.8 | 24.9 |
| Tuna, halibut, orange roughy or Chilean seabass | 23.0 | 13.2 | 13.2 |
| Shark, swordfish, tilefish or king mackerel | 6.6 | 0.8 | 1.2 |
| Other purchased fish | 47.5 | 44.0 | 40.5 |

**Table C-3.** Types of fish eaten by new mothers with a college or graduate degree before, during, and after pregnancy (percent).

| | Before pregnancy | During pregnancy | After giving birth |
|---|---|---|---|
| Types of fish eaten | | | |
| Did not eat fish | 9.0 | 10.3 | 11.1 |
| Sport-caught fish | 26.2 | 11.8 | 12.4 |
| Shellfish | 78.2 | 67.5 | 64.0 |
| Canned “light” tuna | 57.0 | 41.9 | 41.5 |
| Caned “white” tuna (albacore) | 41.5 | 23.4 | 25.8 |
| Salmon | 61.1 | 46.1 | 44.1 |
| Tuna, halibut, orange roughy or Chilean seabass | 31.1 | 8.3 | 16.8 |
| Shark, swordfish, tilefish or king mackerel | 11.4 | 1.1 | 3.3 |
| Other purchased fish | 59.8 | 48.1 | 45.4 |

**Table C-4.** Changes in amount of fish meals consumed during pregnancy compared to before pregnancy (percent), by education level.

| | Education* | | |
|---|---|---|---|
| | HS diploma or less | Some college | College or graduate degree |
| Did not eat fish or shellfish before or during pregnancy | 21.3 | 14.3 | 9.2 |
| Ate a lot more during pregnancy compared to before | 3.9 | 0.4 | 1.2 |
| Ate a little more | 7.9 | 5.3 | 4.9 |
| Ate the same amount | 25.2 | 34.0 | 27.9 |
| Ate a little less | 22.0 | 16.0 | 31.9 |
| Ate a lot less | 11.8 | 20.5 | 20.7 |
| Stopped eating | 7.9 | 9.4 | 4.2 |

* Statistically significant difference between groups at $P \leq 0.05$ using chi-square test.

**Table C-5.** Changes in amount of fish meals consumed after the baby was born compared to during pregnancy (percent), by education level.

| | Education* | | |
|---|---|---|---|
| | HS diploma or less | Some college | College or graduate degree |
| Did not eat fish or shellfish before or during pregnancy | 22.2 | 15.6 | 9.4 |
| Ate a lot more during pregnancy compared to before | 7.1 | 5.3 | 4.5 |
| Ate a little more | 11.1 | 20.1 | 30.4 |
| Ate the same amount | 35.7 | 45.5 | 45.9 |
| Ate a little less | 10.3 | 7.0 | 7.3 |
| Ate a lot less | 6.3 | 4.1 | 1.4 |
| Stopped eating | 7.1 | 2.5 | 1.2 |

* Statistically significant difference between groups at $P \leq 0.05$ using chi-square test.

**Table C-6.** Sport-caught and purchased fish consumption of new mothers during pregnancy (percent), by education level.

| | Education* | | |
|---|---|---|---|
| Fish consumption during pregnancy | HS diploma or less | Some college | College or graduate degree |
| None | 26.7 | 18.4 | 11.3 |
| Less than 1 meal a month | 18.3 | 23.6 | 21.4 |
| 1 to 3 meals a month | 38.2 | 38.4 | 47.5 |
| At least 1 meal per week | 13.0 | 14.8 | 16.1 |
| At least 2 meals per week | 3.1 | 2.8 | 3.5 |
| 3 or more meals per week | 0.0 | 1.2 | 0.2 |
| Don’t know | 0.8 | 0.8 | 0.0 |

* Statistically significant difference between groups at $P \leq 0.05$ using chi-square test.

**Table C-7**. Knowledge of advisory information (percent), overall and by state of residence.

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **Children's health can be harmed more than adult's health by chemical contaminants in fish** *(generally true)* | | | | |
| Strongly agree | 15.8 | 15.2 | 17.0 | 14.1 |
| Agree | 43.7 | 43.2 | 44.2 | 42.9 |
| Neutral | 7.1 | 7.1 | 7.0 | 7.2 |
| Disagree | 2.0 | 3.9 | 0.9 | 2.3 |
| Strongly disagree | 0.2 | 0.6 | 0.0 | 0.3 |
| Don't know | 31.2 | 30.0 | 30.9 | 33.2 |
| **Some chemical contaminants from eating fish build up in my body over time** *(generally true)* | | | | |
| Strongly agree | 15.7 | 18.3 | 15.0 | 14.7 |
| Agree | 42.2 | 41.2 | 41.9 | 43.8 |
| Neutral | 10.9 | 13.2 | 10.1 | 10.1 |
| Disagree | 4.8 | 3.5 | 5.3 | 4.9 |
| Strongly disagree | 0.7 | 1.3 | 0.4 | 0.7 |
| Don't know | 25.7 | 22.5 | 27.3 | 25.8 |
| **Older fish generally have more chemical contaminants in them than younger fish** *(generally true)* | | | | |
| Strongly agree | 10.4 | 13.5 | 7.8 | 12.4 |
| Agree | 32.8 | 36.7 | 30.9 | 32.7 |
| Neutral | 10.2 | 12.3 | 9.1 | 10.1 |
| Disagree | 4.3 | 3.9 | 4.8 | 3.9 |
| Strongly disagree | 0.8 | 1.0 | 0.9 | 0.3 |
| Don't know | 41.5 | 32.6 | 46.5 | 40.6 |
| **Fish that eat other fish tend to have more chemical contaminants than fish that eat other things** *(generally true)* | | | | |
| Strongly agree | 8.8 | 11.7 | 7.0 | 9.8 |
| Agree | 23.0 | 24.4 | 22.6 | 22.5 |
| Neutral | 10.8 | 10.7 | 10.4 | 11.8 |
| Disagree | 4.7 | 4.2 | 4.3 | 5.9 |
| Strongly disagree | 0.4 | 0.6 | 0.0 | 1.0 |
| Don't know | 52.3 | 48.4 | 55.7 | 49.0 |

Continued on next page

**Table C-7** continued

| | Overall | MN | PA | WI |
|---|---|---|---|---|
| **I know which fish eat other fish and which fish eat other things** | | | | |
| Strongly agree | 1.9 | 2.6 | 1.7 | 1.6 |
| Agree | 13.0 | 13.2 | 11.8 | 15.4 |
| Neutral | 12.1 | 13.5 | 12.2 | 10.5 |
| Disagree | 17.4 | 18.3 | 15.7 | 20.1 |
| Strongly disagree | 7.0 | 7.1 | 7.4 | 6.2 |
| Don't know | 48.6 | 45.3 | 51.2 | 46.2 |
| **Fish from lakes outside the metro area are safer to eat than fish from lakes inside the metro area** *(generally false)* | | | | |
| Strongly agree | -- | 2.9 | -- | -- |
| Agree | -- | 16.1 | -- | -- |
| Neutral | -- | 14.2 | -- | -- |
| Disagree | -- | 14.5 | -- | -- |
| Strongly disagree | -- | 2.9 | -- | -- |
| Don't know | -- | 49.4 | -- | -- |
| **Smaller fish generally have more chemical contaminants in them than larger fish** *(generally false)* | | | | |
| Strongly agree | 0.6 | 1.6 | 0.0 | 1.0 |
| Agree | 2.5 | 2.9 | 2.6 | 2.0 |
| Neutral | 10.6 | 10.6 | 10.0 | 11.8 |
| Disagree | 18.9 | 25.2 | 16.5 | 17.4 |
| Strongly disagree | 6.7 | 7.1 | 6.5 | 6.6 |
| Don't know | 60.7 | 52.6 | 64.4 | 61.2 |
| **Most of the mercury is found in the fat of fish** *(generally false)* | | | | |
| Strongly agree | 4.1 | 4.8 | 3.5 | 4.6 |
| Agree | 16.1 | 16.8 | 15.7 | 16.1 |
| Neutral | 11.7 | 11.6 | 10.5 | 14.1 |
| Disagree | 3.8 | 3.2 | 3.9 | 4.3 |
| Strongly disagree | 0.3 | 1.0 | 0.0 | 0.3 |
| Don't know | 64.1 | 62.6 | 66.4 | 60.6 |

**Table C-8**. Knowledge of advisory information more closely related to sport-caught fish (percent), by consumption of sport-caught fish.

| | Ate sport-caught fish | Did not eat sport-caught fish |
|---|---|---|
| **Older fish generally have more chemical contaminants in them than younger fish*** *(generally true)* | | |
| Strongly agree or agree | 48.7 | 41.1 |
| Neutral | 9.9 | 10.3 |
| Strongly disagree or disagree | 8.1 | 4.0 |
| Don't know | 33.3 | 44.6 |
| **Fish that eat other fish tend to have more chemical contaminants than fish that eat other things** *(generally true)* | | |
| Strongly agree or agree | 35.6 | 30.5 |
| Neutral | 10.4 | 11.1 |
| Strongly disagree or disagree | 7.2 | 4.4 |
| Don't know | 46.8 | 54.0 |
| **I know which fish eat other fish and which fish eat other things*** | | |
| Strongly agree or agree | 21.2 | 12.8 |
| Neutral | 11.7 | 12.3 |
| Strongly disagree or disagree | 25.7 | 24.1 |
| Don't know | 41.4 | 50.8 |
| **Smaller fish generally have more chemical contaminants in them than larger fish*** *(generally false)* | | |
| Strongly agree or agree | 2.3 | 3.5 |
| Neutral | 10.9 | 10.5 |
| Strongly disagree or disagree | 32.6 | 23.1 |
| Don't know | 54.2 | 62.9 |
| **Most of the mercury is found in the fat of fish** *(generally false)* | | |
| Strongly agree or agree | 26.1 | 18.0 |
| Neutral | 9.0 | 12.6 |
| Strongly disagree or disagree | 4.1 | 4.2 |
| Don't know | 60.8 | 65.2 |

*Statically significant difference between groups at $P \leq 0.05$ using chi-square test.